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HISTOCHEMISTRY OF THE CONNECTIVE TISSUE OF THE COCHLEA.*†‡

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INTRODUCTION.

Previous histological studies[1,2,3,4] on the membranous labyrinths of animals exposed to intense sound have been primarily concerned with changes in sensory and supporting cells and membranes such as Reissner's. Attempts have been made to correlate electrophysiological results with these changes. It has been apparent for some time that other histological changes such as degenerative connective tissue lesions[1,5] occur in the same specimens in response to these exposures. These have been considered to be of secondary importance in the interpretation of the experimental results. They are not consistently present in all animals, and many do not occur in the same turns of the cochlea in which the greatest injuries to the organ of Corti are located. No correlation seems to exist between the lesions in connective tissue and electrical potentials of the cochlea although it is conceivable that extensive

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changes could indirectly alter proper function of the organ of Corti.

The present-day interest has been centered mainly upon the localization of enzymes in the cochlea particularly in relation to sensory and supporting cells under control and experimental conditions. The localization in cochlear structures of cytochrome oxidase and succinic dehydrogenase[6,7] and acetyl cholinesterase[8] has been reported.

The present study was undertaken to determine by special staining procedures additional information regarding histochemical composition of the different structures of the cochlea. While these experiments are particularly concerned with the connective tissue, an attempt is made finally to correlate the findings with those described by others for enzyme localization and distribution. A study of the limbus spiralis and spiral ligament in normal and experimental animals seemed to offer an opportunity for a better understanding of these cochlear structures and any degenerative changes.

The nature and characteristics of the degenerative changes in the limbus and spiral ligament following exposure to intense sound, led to the suggestion that special staining techniques particularly adequate for the study of intercellular substance should be employed for sections of the cochlea. A previous histochemical study of the cochlea was reported by Plotz and Perlman,[9] who utilized cochleas of bats stained by Hotchkiss' periodic acid-Schiff method. They described the limbus and spiral ligament in detail, but their observations included only normal material.

MATERIAL AND METHODS.

The material for the present experiments comprised three different groups of guinea pigs: the first group consisted of eight unexposed young guinea pigs with good hearing, as judged by the pinna reflex. After deep anesthesia, the temporal bones were rapidly removed. Under a dissection microscope the bulla of each ear was opened to expose the cochlea. The bone of the cochlea was removed from the apex and into the first turn with a stapes mobilization footplate chisel.

Markings of the stria vascularis, Reissner's membrane and the osseous spiral lamina were then visible. Drops of liquid dichlorodifluoromethane (Freon 12) were poured over the exposed cochlear partitions. Small strips of frozen cochlear duct were then removed and immediately placed in a small beaker containing dichlorodifluoromethane. During further dissection this vessel was repeatedly dipped into liquid nitrogen which was not allowed to come into contact with the tissues. When dissection ended each strip of cochlear duct was placed in a dry tube which had been previously immersed in liquid nitrogen. Each tube was then placed in the drying chamber of the freeze-drying apparatus for 48 to 72 hours. The frozen-dried pieces were then vacuum-embedded in 56-58° C. paraffin and sectioned at 5 microns.

The second group was comprised of four unexposed young guinea pigs with normal hearing. They were given light anesthesia, and their bullas were opened to expose the cochleas. Small holes were made in the apex of each cochlea which was then perfused through the round window membrane with 10 per cent formalin (one guinea pig) or cold 80 per cent alcohol (three guinea pigs). The animals were decapitated and the excised temporal bones were placed in the same fixative used for perfusion and allowed to remain 24 hours. They were subsequently decalcified in sodium acetate solution buffered to a pH of 4.5 and following dehydration and clearing, were embedded in paraffin and sectioned at 8 microns.

The third group comprised three unexposed and 12 exposed guinea pigs perfused with Heidenhain-Susa's solution, decalcified in 3 per cent hydrochloric acid, dehydrated and embedded in celloidin and sectioned at 15 microns. The frequencies of the exposures varied from 500 to 10,000 cycles per second at intensities from 142 to 156 decibels (sound pressure level). The durations of the exposures were from one to four minutes, and the animals were allowed to survive from 0 to 64 days.

Sections from all three groups were stained by the following methods:

1. Harris' Hematoxylin and Eosin.
2. Periodic acid-Schiff reaction.
3. Colloidal iron.
4. Colloidal iron followed by periodic acid-Schiff.
5. Alcian blue.
6. Alcian blue followed by periodic acid-Schiff.

The periodic acid-Schiff reaction has been extensively used in histological and histochemical investigation.[10,11] There is neither necessity nor reason to discuss it in detail here. It is sufficient to say that the periodic acid oxidizes the carbon bonds of certain types of carbohydrate groups converting them to dialdehydes which combine with the Schiff reagent to yield a red dye. The color intensity is proportional to the number of groups freed in the oxidation process. The method of McManus was employed in these experiments.

The colloidal iron method depends on the affinity of free acidic groups for dialyzed colloidal $Fe^{\cdot\cdot\cdot}$. The iron that is bound is subsequently evidenced by a Prussian blue reaction. This is likewise a method extensively used.[10,11] The procedure used in this series was the modification of Hale's original method by Rinehart and Abul-Haj.[12]

Combinations of periodic acid-Schiff and colloidal iron staining have been used. Some investigators do not advise their combined use because of the masking effect of the aldehyde reaction which leads to much less reaction with the iron than would be expected. In these experiments it was found that by reversing the procedure, that is, staining with the iron first and then the periodic acid-Schiff method, vividly colored sections were obtained that readily lent themselves to a comparison of results for each procedure.

The nature of the alcian blue reaction remains to be determined, and its histochemical sensitivity and specificity are not entirely clear. The specificity for certain complex substances which will be discussed later is increased considerably when the staining procedure is carried out in an acid pH. The

method of Steedman was used in these experiments with the use of neutral red as a counterstain. The combination of this method with the periodic acid-Schiff procedure proved to be of interest for substances which react differently with each and produce different color combinations.

Sections pretreated with testicular hyaluronidase were used as controls for all methods. Methylene blue extinction tests were also performed to identify further the substances yielding positive reactions with the mentioned procedures.

FINDINGS.

The designation of limbus spiralis is usually applied to the mass of connective tissue, surmounted by epithelial cells, that rests on the vestibular side of the osseous spiral lamina, but, correctly speaking, it consists of vestibular and tympanic portions through which the peripheral nerve fibers pass to the spiral ganglion cells. The term, limbus, in this study is used to designate only the vestibular portion. It is particularly prominent in the guinea pig. The connective tissue has a firm almost homogeneous intercellular substance and contains stellate connective tissue cells. The teeth of Huschke which constitute a means of attachment of the tectorial membrane are upward prolongations of the connective tissue between the epithelial cells. The fibers of the basilar membrane on entering the limbus spread into a fan-like framework which surrounds the stellate cells. A few blood vessels are to be seen in its substance.

Following the exposure of guinea pigs' ears to intense sound of 130 or more decibels sound pressure level, for one to four minutes, the limbus frequently shows degenerative changes within a few minutes. These are characterized by shrinkage of the nuclei of the stellate connective tissue cells which results in a deeper staining with hematoxylin. In guinea pigs that are allowed to survive for a few days subsequent to the exposure, nuclei then stain less intensely but pyknosis and karyorrhexis are also in evidence. With longer post-exposure lives (1-2 weeks) the nuclei disappear entirely except for remaining fragments of nuclear membranes. The

cells become shrunken, and intercellular substance disappears, at first in the regions in close proximity to the internal spiral sulcus. In approximately one month of post-exposure life all detail except the fibrillar framework may be completely lacking as shown in Fig. 1. The fibers maintain normal distribution, and endothelial cells of the blood vessels are also

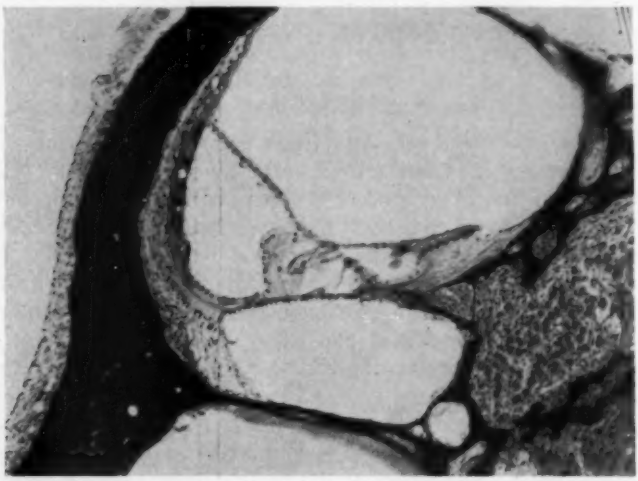

Fig. 1. View of the scala media of the upper part of the third turn of a cochlea of a guinea pig exposed to a tone of 4 kc.p.s. at an intensity of 153.5 db for 2 minutes and allowed to survive for 64 days. The limbus shows degenerative changes consisting of disappearance of stellate connective tissue cells and intercellular substance. The spindle-shaped cells on the vestibular margin of the limbus have also disappeared. The scala tympani portion of the spiral ligament shows loss of cells and intercellular substance. (Hematoxylin and eosin, X100.)

usually intact, at least during the earlier stages. The epithelial cells underlying the tectorial membrane may be degenerated, but this is not the usual finding. The thin endothelial-like cells on the scala vestibuli surface of the limbus frequently disappear as found with prolonged post-exposure life. The degenerative alterations exhibited by the connective tissue do not lead to any noticeable change in the size and shape of the limbus. These remain very much the same even several months after the exposure to sound.

The injuries to the limbus usually do not occur in the same area of the cochlear partition where damage to the sensory and supporting cells of the organ of Corti is most severe. This region is often spared, and the most extensive changes are frequently found on either side of it. Occasionally the degenerative lesions extend into the most apical or basal turns or both.

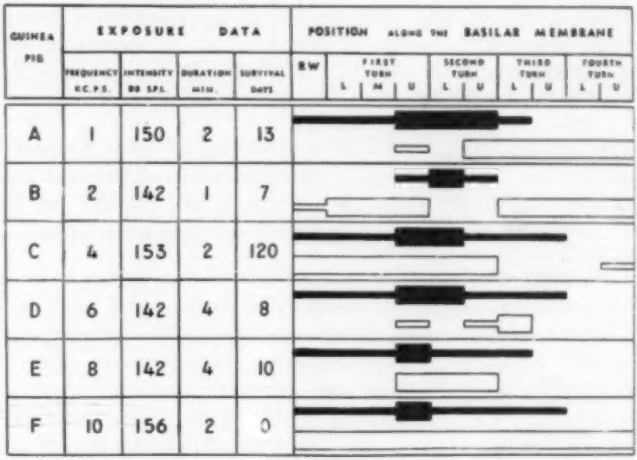

Fig. 2. Changes in the hair cells of the organ of Corti shown in black, and in the limbus spiralis in outline for six guinea pigs exposed to high intensity sounds (142 to 156 db S.P.L.) at different frequencies (1 to 10 kc.p.s.) for one to four minutes and allowed to survive from 0 to 120 days after the exposure. The wide areas denote marked changes and the narrow, minor alterations. These guinea pigs were picked at random from a series to illustrate typical findings.

Fig. 2 shows a few typical examples of the relation in position along the basilar membrane between lesions in the limbus and damage to the hair cells of the organ of Corti. These data were randomly selected from a large series. Similar information is available in the literature.[1,2]

The spiral ligament, like the limbus, is primarily a connective tissue structure. A vestibular and a tympanic portion may be artificially created with the help of a horizontal

line prolonging the basilar membrane through the spiral ligament. The scala vestibuli portion is rich in fibers, and the blood vessels, sometimes of relatively large caliber, are numerous. The cells are also stellate connective tissue cells and are more numerous than in the limbus. The intercellular substance is quite homogeneous behind the stria vascularis and the spiral prominence, but it is less so in proximity to the bone where cells and nuclei are smaller. The fibers of the basilar membrane form a firm framework around the cells and blood vessels, and, at the point of their entrance into the spiral ligament, a region is found which is devoid of cells and homogeneous in aspect. In mid-modiolar sections this region is triangular in shape.

The scala tympani portion is made up of loose connective tissue and lacks the homogeneous appearance of the vestibular portion. Relatively large blood vessels are equally present, but fibers and connective tissue cells are less numerous.

Following exposure to intense sound the changes in the spiral ligament are not so marked or so frequent as those of the limbus, and they are mainly confined to the scala tympani portion. The degenerative alterations appear soon after the exposure. At first they are characterized by occasional pyknosis and karyorrhexis of cells. Later some connective tissue cell proliferation occurs that is followed by loss of cells and intercellular substance (see Fig. 1). The lesions show a tendency to extend toward the superior and peripheral areas of the scala vestibuli portion of the spiral ligament. Unlike those of the limbus these changes occur in the same turns of the cochlea in which the changes in the organ of Corti, particularly in the hair cells, are most intense.

For the histochemical evaluation of these structures and their changes, the celloidin sections were superior to the paraffin for the preservation of normal relationships. The celloidin, however, was stained with the colloidal iron and alcian blue procedures and had to be removed by means of acetone before an evaluation of the histochemical structure of the tissues could be made. The paraffin sections were important to control the validity of these estimations. Sections of the

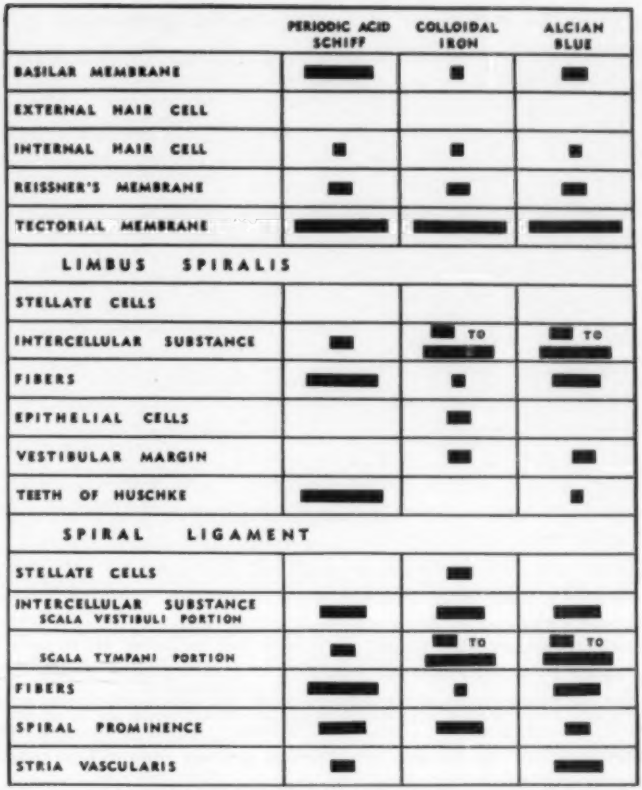

Fig. 3. The estimated amount of reaction obtained by the three basic methods for different structures of the guinea pig's cochlea. The lengths of the blackened areas correspond to the gross amount of reaction substance by each method. The results by use of the combined methods are not shown.

dissected strips of cochlear duct were utilized to verify the effects of various technical procedures, such as fixatives and decalcifying agents, on the results obtained by the other methods.

Fig. 3 is based on the findings for the three groups of guinea pigs. The basilar membrane and the hair cells of the organ of Corti were included in the chart for comparison and

so were the structures in relation to the limbus and spiral ligament such as tectorial and Reissner's membranes and the stria vascularis.

The basilar membrane was well stained with the periodic acid-Schiff procedure but was stained red in the colloidal iron preparations which also stained collagen fibers red. It was also deep red in the sections stained with the combination of both procedures but less stained in the alcian blue sections. In the combination of alcian blue and P.A.S. it was noticeable that the P.A.S. reaction was stronger. The stainability of the basilar membrane did not change with the exposure to intense sound. Even in the specimens with only remnants of the organ of Corti the basilar membrane was stained as usual.

The cytoplasm of the external hair cells did not stain with any of the procedures utilized whereas that of the inner hair cells showed a slight reaction to the P.A.S. and alcian blue methods although not with the colloidal iron technique. On the other hand the vicinity of the distal ends of the supporting cells of both external and internal hair cells presented a very strong reaction with the colloidal iron (see Fig. 4). This was not apparent in the areas exhibiting marked degenerative changes in the organ of Corti.

The stellate connective tissue cells in the limbus spiralis did not yield positive reactions with any of the staining procedures either in normal or exposed guinea pigs. The intercellular substance retained its homogeneity in the sections stained by the P.A.S. technique being slightly P.A.S. positive. With both colloidal iron and alcian blue this slightly positive reaction was maintained but there were regions showing stronger reactions. These regions were almost invariably found in proximity to the attachment of Reissner's membrane (see Fig. 4). Their surface areas were smaller in the basal turns and larger in the upper turns; furthermore these regions had a tendency to diminish in the specimens subjected to high intensity sound.

The fibrillar framework of the limbus has a rather strong positive reaction with the P.A.S. procedure. These fibers are

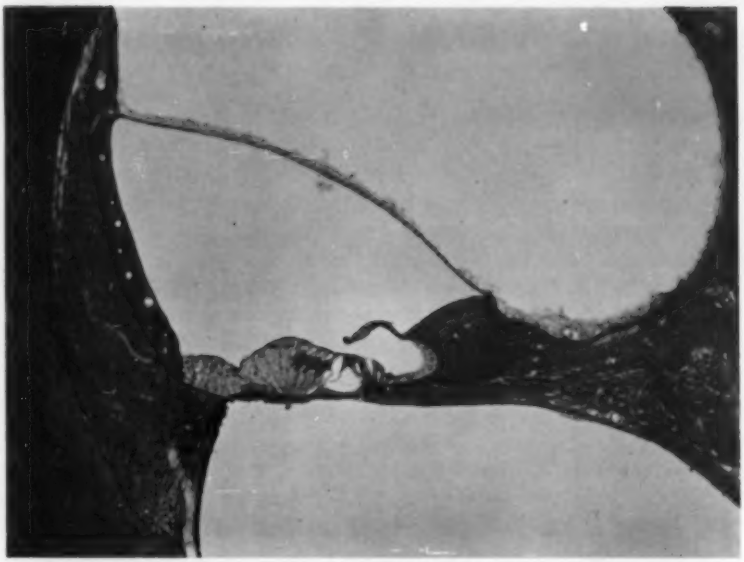

Fig. 4 — Upper part of the first turn of a cochlea of a guinea pig. Deeply stained blue areas in the limbus are acid mucopolysaccharides. They are mostly present in the vicinity of the endothelial-like cells of the vestibular margin and inner portion of the tectorial membrane attachment. Similar substances are found scattered in the spiral ligament, homogeneously distributed in the vestibular portion and somewhat irregularly present in the tympanic portion. Other stained areas are seen in the vicinity of the distal ends of the supporting cells of both external and internal hair cells and the textorial membrane. Celloidin-embedded preparation, stained with colloidal iron—P.A.S., X63.

stained red with colloidal iron as are those of the basilar membrane. They are poorly stained with alcian blue. No difference in the stainability or general appearance of the fibers was noted in the specimens exposed to sound.

The cytoplasm of the epithelial cells of the limbus showed a slightly positive reaction with colloidal iron but showed no reaction with the P.A.S. or alcian blue methods. Degeneration of the epithelial cells following exposure was present in only one guinea pig in this series and it was associated with detachment of the tectorial membrane. It may be possible that the degeneration of the epithelial cells ensues only when such a detachment occurs. Similarly exposed animals failed to present this rather uncommon finding.

The tectorial membrane was deeply stained by the P.A.S. procedure exhibiting a deep red coloration comparable to that of the basilar membrane. Similarly, it stained deeply with the alcian blue and almost as well with the colloidal iron. With the latter method, however, red-stained fibers were also in evidence. The teeth of Huschke stained intensely with the P.A.S. but showed little or no reaction with alcian blue and no reaction with colloidal iron.

The endothelial-like cells that separate the inner margin of the limbus from the scala vestibuli are not stained with any of the procedures, but a delicate basement membrane exists between them and the limbus which is lightly stained with colloidal iron and alcian blue methods. No reaction was obtained with the P.A.S. This basement membrane is missing when the endothelial-like cells disappear following exposure to sound. An equally delicate basement membrane is present between the layers of cells in Reissner's membrane and is lightly stained with all procedures. There is no evidence of repair activity in the limbus even in specimens with prolonged post-exposure lives.

The spiral ligament connective tissue cells were quite like those of the limbus except they showed a slightly positive reaction with colloidal iron. Although there were variations in the number of cells there were no discernible changes in them

following exposure to sound. With respect to the intercellular substance there was a noticeable difference between the scala vestibuli and the scala tympani portions (see Fig. 4). In the scala vestibuli portion the intercellular substance is homogeneous and stains well with all methods. The scala tympani portion is less homogeneous and stains lightly with the P.A.S. method. With colloidal iron and alcian blue, as in the limbus, certain regions showed a more intense reaction while others were stained lightly. The triangular-shaped homogeneous region located at the point where the basilar membrane reaches the spiral ligament was deeply stained with all methods.

The fibers were strongly P.A.S. positive but were stained red in the colloidal iron preparations and were stained rather feebly with alcian blue. The spiral prominence exhibited positive reactions with all methods. The stria vascularis showed some reaction with the P.A.S. and alcian blue methods but did not stain with colloidal iron.

Repair activity in the spiral ligament was occasionally seen. It consisted mainly of fibroblastic proliferation usually in the regions of the scala tympani area close to the scala vestibuli portion. In the colloidal iron and alcian blue preparations the more reactive areas apparent in the scala tympani portion showed a tendency to diminish in the cochleas previously exposed to sound. The specimens with long post-exposure lives showed fewer such regions. The intercellular substance of the scala vestibuli portion failed to reveal similar changes.

Treatment of sections with testicular hyaluronidase (Wyeth) prior to the staining procedures served as a control for the results of the methods used. For the P.A.S. procedure it was found that all positive reactions were either abolished or largely diminished with the exception of the stria vascularis. All positive reactions were abolished or largely reduced with the colloidal iron method. In the alcian blue preparations the basilar membrane and the fibers in the limbus and in the spiral ligament continued to yield a mildly positive reaction of approximately the same intensity

as that of the untreated specimens, but all other positive reactions were greatly reduced or abolished.

Methylene blue extinction tests were performed as an aid to the identification of the substances producing positive reactions. The method described by Dempsey and Singer[13] was employed. Colorimetric estimations were omitted be-

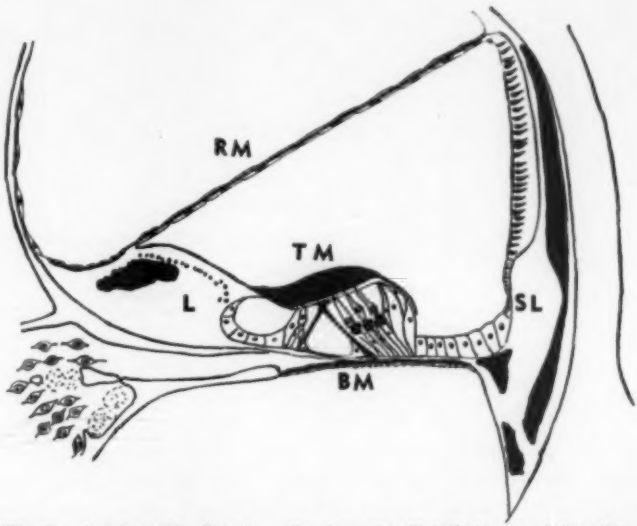

Fig. 5. A schematic drawing showing the distribution and location of acid mucopolysaccharides (blackened areas) in the guinea pig's cochlea. These substances are present in the limbus (L), spiral ligament (SL), tectorial membrane (TM), between layers of cells in Reissner's membrane (RM) and between the scala tympani mesothelial cells and basilar membrane (BM). Concentrations of acid mucopolysaccharides are present in or near the distal ends of the phalangeal cells of the organ of Corti.

cause precise quantitative information was not considered necessary for the present study. The areas of different structures that were positive with the colloidal iron method also reacted with the methylene blue at pH values up to about 4.5. At pH 4.66 the reaction was much less and was negligible at higher values.

Fig. 4 shows schematically the structures which yielded

positive reactions with colloidal iron, alcian blue and methylene blue, respectively.

DISCUSSION.

It is well known that such staining procedures as the colloidal iron and alcian blue methods do not parallel the findings with the use of the periodic acid-Schiff reaction. These dyes react with chemically different structural groups. It has been demonstrated that a positive P.A.S. reaction is obtained with unsaturated lipids and phospholipids which in paraffin sections are not present, or only in negligible amounts. It is justifiable to assume that the only material which would substantially contribute to a positive P.A.S. reaction in the present series would be carbohydrate-protein complexes including neutral mucopolysaccharides, muco- and glycoproteins.[11,14] It has also been demonstrated[11] by histochemical and *in vitro* tests that acid mucopolysaccharides do not react with the P.A.S.

Acid mucopolysaccharides are extremely sensitive to colloidal iron and alcian blue methods. This selectivity for staining and the results obtained with the methylene blue extinction test justify the conclusion that the material in isolated areas in the limbus and in the scala tympani portion of the spiral ligament and scattered in the scala vestibuli portion of the same structure is primarily of the nature of acid mucopolysaccharides. This material lies in close relation to the fibers and is usually present in the vicinity of the stellate connective tissue cells.

The triangular-shaped homogeneous region found at the point where the basilar membrane fibers enter into the spiral ligament is the richest in acid mucopolysaccharides. This correlates with the studies of Vosteen,[6,7] who reported that this region was particularly rich in cytochrome oxidase.

In or near the distal ends of the supporting cells of the hair cells of the organ of Corti large acid mucopolysaccharide contents are apparent (see Fig. 4) which are not seen when the organ of Corti is damaged by intense sound. Existence

of cytochrome oxidase in or near the basal ends of the hair cells has been described[6,7] and has been shown to decrease in animals intoxicated with potassium cyanide or exposed to intense sound. The exact locations of the acid mucopolysaccharides and the enzyme, however, are probably not identical. In the tectorial membrane a concentration of acid mucopolysaccharides is also apparent.

The basilar membrane, the fibers of the limbus and spiral ligament and the teeth of Huschke are all P.A.S. positive but contain little or no acid mucopolysaccharides, as shown by colloidal iron and alcian blue methods.

The connective tissue structures of the cochlea differ to some extent from other similar tissues elsewhere in the animal organism. For example, the usual response to injury is manifested first by an attempt to remove the offending agent and secondly to initiate repair of the damaged area by local and circulatory responses. Proliferation of new connective tissue cells and production of new fibers usually result. In tissue cultures it has been shown[15] that fibroblasts begin very early to produce collagen fibers and possibly also intercellular substance. The state of aggregation of the intercellular substance depends upon the degree of polymerization of its constituent mucopolysaccharides and varies during the repair activities due to the increased necessity of diffusion and permeability.[16] After a long post-injury recovery period one would expect to find either a perfectly normal structure or one replaced to variable degrees by new fibrous connective tissue.[17]

In the limbus spiralis and in the scala tympani portion of the spiral ligament the degenerative changes that follow the exposure to intense sound are irreversible to a considerable degree. Repair as seen in other similar tissues does not occur in this instance, and healing in the true sense of the term is not identifiable at any stage during recovery period. Repair of the denuded basilar membrane subsequent to loss of the organ of Corti is evidenced by proliferation of low cuboidal epithelium. Such is not true of connective tissue structures of the inner ear. It is interesting to note that the areas of

limbus and spiral ligament that show the effects of intense sound exposure are relatively poor in acid mucopolysaccharides.

Since the scala tympani portion of the spiral ligament is usually affected by the exposure its relationship to the movements of the basilar membrane might prove to be significant. With ordinary staining procedures most of the basilar membrane fibers in the spiral ligament appear to be directed toward the scala tympani portion. The injury to this area then might be accounted for by the larger concentration of these fibers which are subjected to severe tension during the exposure to intense sound. When adequate methods for staining collagen fibers are used, such as the colloidal iron procedure, it is found that the fibers are almost evenly distributed and become more apparent in the scala tympani portion due to the lesser amount of intercellular substance in this region. Mechanical injury is not the only type of injury to which this area is vulnerable. Kimura and Perlman[15] described early changes for this part of the spiral ligament, as well as for the limbus, after extensive venous obstruction. They found that the scala vestibuli portion was involved only in specimens with marked degenerative changes.

There seems to be little doubt that the small amount and peculiar distribution of acid mucopolysaccharides in the limbus and scala tympani portion of the spiral ligament is to be correlated with degenerative changes attributed to exposure to high intensity sound.

New fibers, newly produced acid mucopolysaccharides and fibroblastic proliferation, as evidence of processes of repair, are particularly lacking in the damaged limbus. This observation leads to the suggestion that the connective tissue of the cochlea is different from other histologically similar types of connective tissue in its capacity for reaction to injuries or disease. Further studies on embryological development of this supporting tissue may bring forth some explanation for its peculiar qualities. It is not justifiable at present to attribute its differences to an arrested stage in development

such as that frequently suggested for the enchondral layer of bone of the otic capsule.

CONCLUSIONS.

1. The limbus spiralis is a structure containing small amounts of irregularly distributed acid mucopolysaccharides. They show a tendency to accumulate in the proximity of the vestibular margin of the limbus or in the vicinity of attachment of Reissner's membrane.

2. The acid mucopolysaccharides in the limbus are diminished in cochleas of animals subjected to intense sound exposures. Regeneration in animals with prolonged post-exposure lives does not occur.

3. The scala vestibuli portion of the spiral ligament is rich in homogeneously distributed acid mucopolysaccharides. In the scala tympani portion they are present in smaller amounts, and their distribution is irregular.

4. The appearance of degenerative changes in the limbus spiralis and spiral ligament after exposure of animals' ears to intense sound seems to bear a relation to the areas containing smaller amounts of acid mucopolysaccharides.

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GILL MEMORIAL EYE, EAR AND THROAT HOSPITAL 34TH ANNUAL SPRING CONGRESS.

The Gill Memorial Eye, Ear and Throat Hospital will hold its Thirty-Fourth Annual Spring Congress in Ophthalmology and Otolaryngology and Allied Specialties, April 3-8, 1961. There will be 20 guest speakers and 50 lectures.

SYNDROME OF WAARDENBURG WITH DEAFNESS.*

SILVIU ZELIG, M.D.,

Jerusalem, Israel.

A syndrome presenting inherited anomalies of the interoculary region, disturbances of pigmentation, and deafness, was first described by Waardenburg[4] in 1950. He reported five main features of the syndrome:

a. Lateral displacement of the nasal corners of the eyes.

b. Broad nasal bones with eyebrows meeting on the medial line.

c. Differently colored eyes (Heterochromous iridium).

d. A white forelock.

e. Nerve deafness.

The syndrome does not necessarily appear complete, but generally it presents as a combination of two or more of the signs. The abnormality of the eyes is considered the most important sign. Deafness is found in only 20 per cent of the cases (Waardenburg). Defective pigmentation can appear in different places on the body, and sometimes only as early greying of the hair.

Waardenburg found the characteristics of this syndrome in 12 children after an examination of 840 deaf children in five schools for the deaf in the Netherlands. Other authors[1,2,3,5] have since reported several cases of this syndrome.

We recently had occasion to examine a family who presented some interesting characteristics of this syndrome.

A four-year-old boy was admitted to the Out-Patient Department suffering from deafness. A white lock on the forehead, eyes wide apart and light blue in color (unusual on a dark skinned child) aroused the suspicion of Waardenburg's syndrome.

Further examination of the patient, who was born in Israel, to parents

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who immigrated from India, revealed eyes wide apart with eyelids closed on the proximal sclera and the lacrimal gland point above the iris; wide root of the nose with very wide eyebrows; blue pale irises dotted with black points. A white lock of hair on the forehead and a patch of white hair on the right arm were found (see Fig. 1). Neurological examination was negative. Otoscopic examination disclosed normal ear drums. No response to maximal audiometric stimuli could be obtained. Vestibular examination by caloric and rotary tests gave no reaction.

Fig. 1. Illustrates the appearance of the eyes, nose and the white forelock.

The members of the family were then examined. No characteristics of the syndrome were found in the father. The mother, a 24-year-old woman, showed characteristic abnormalities of the eyelids with heterochromia of the irises (one iris blue and the other dark brown). Her hair turned grey several years ago (see Fig. 2). Examination of hearing by audiometry, disclosed left subtotal nerve deafness (see Fig. 3). The hearing of the right ear was normal.

A young brother of the patient, aged three years, presented an abnormality of eyelids only, his hearing being normal.

Fig 2. Illustrates the appearance of the eyes with heterochromous iridium and greying of the hair.

A baby sister, six months old, showed abnormal eyelids, wide interocular region and also several white hairs on the forehead. A hearing examination was not conclusive.

COMMENT.

Waardenburg believes that the characteristic genetic traits of this syndrome are inherited dominantly, whereas Wilderwank[5] has suggested that one or more of the abnormalities found may appear during embryonal life, probably in the second month of gestation, due to exogenous causes.

In a recent article by Fisch,[2] a case is described with a post mortem examination. Absence of the organ of Corti and atrophy of the ganglion and nerve were significant findings.

In the family described by us, two members present all the characteristics of the syndrome. The oldest child presents the abnormalities of the eyelids and interocular region, and complete nerve deafness. The blue pale irises with black dots may be considered equivalent to heterochromous iridium. His mother presents also all the characteristics of the syn-

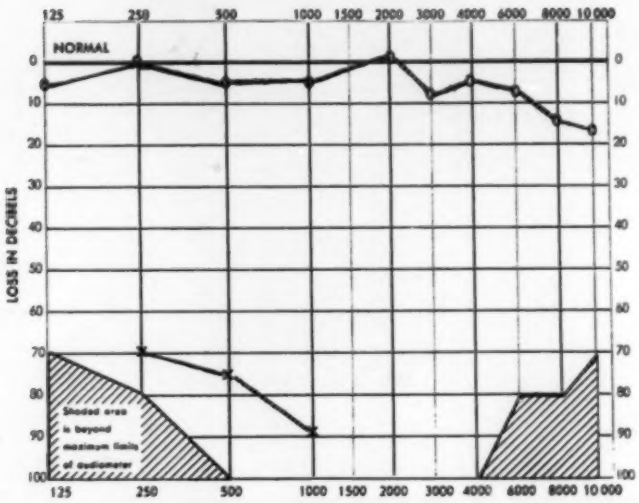

Fig. 3. The audiogram of the mother. O—right ear; X—left ear.

drome with irises of different color. The depigmentation is represented in the mother by early greying of the hair and the deafness appears unilaterally. Both of the younger children present some characteristics of the syndrome.

SUMMARY.

An immigrant family from India, several members of which present signs of the Waardenburg syndrome, is reported. The oldest child and his mother present all the symptoms of the

syndrome; the other two children, one male and one female, are only partially affected.

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GOULD FOUNDATION AWARD.

The William and Harriet Gould Foundation announces the winner of the Gould Award for 1960: Dr. Tanwillen van den Berg of the University of Groningen, The Netherlands. The Award was presented to Dr. van den Berg in recognition of his contributions to laryngeal physiology.

The Gould Award is presented annually for outstanding contributions to basic laryngeal research. The candidate is selected by an International Committee, which at present consists of Professor Cotoji Satta, M.D., Tokyo, Professor Dr. Luzius Rüedi, Zurich, Professeur Georges Portmann, Bordeaux, and Dr. Hans von Leden, Medical Director, 30 North Michigan Avenue, Chicago 2, Ill. The Award includes an illuminated plaque and a cash prize of $350.

FRONTAL BONE CONDUCTION TESTS IN CLINICAL AUDIOMETRY.*

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and
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Chicago, Ill.

INTRODUCTION.

It has been pointed out from time to time that the mastoid process is far from being the best site of application for the bone conduction receiver in threshold audiometry and that a better alternative is available in the forehead.

Bárány has observed that when a bone conduction receiver is placed near the pinna, sound may be carried to the inner ear via the cartilage of the external ear; conduction of sound in this way will invalidate the measurement of clinical bone conduction thresholds and "the mastoid process should not be used in hearing tests."[1]

Békésy has noted that variations of only a few millimeters in the position of a bone conduction receiver, applied to the mastoid, may produce sensitivity changes of 10 db or more. He recommends "the middle of the forehead for standard use, because the uniform thickness of the bone here produces a very regular form of vibration (of the skull), and a shift of the point of application of the vibrator of as much as 3 cm. has no effect upon the loudness of the bone-conducted tone." Another point made by the same author is that "on the forehead the tactile sensations that arise at the low frequencies are more easily discriminated from the sounds."[2]

Hirsh stresses the fact that both cochleas are stimulated more or less equally no matter where the bone conduction

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transducer may be applied on the skull and that at the frontal bone the tissues are more homogeneous over a reasonable area.[3]

The frontal bone site has been used for measurements of clinical bone conduction thresholds by a number of clinicians including Luscher, Naunton,[4] and more recently Jerger,[5] who has embodied the same principle in a bone conduction test (Sensorineural Acuity Level) derived from a test method proposed by Rainville.[6]

It is logical to assume that acceptance of the frontal bone site as the one of choice in clinical audiometry will increase as experience in its use continues to grow and, toward this end, the authors have examined and compared the reliability of clinical bone conduction tests made at the frontal and at the mastoid bones.

EXPERIMENTAL INVESTIGATIONS.

The problem was examined in three ways:

1. Bone conduction thresholds were measured at three specified positions at the frontal and at the mastoid bone in order to demonstrate the effect of deliberate change of the position of the receiver.

2. Bone conduction thresholds were measured at the "best" and "worst" portions at the frontal and mastoid bones, "best" and "worst" being determined subjectively on the basis of the loudness of a white noise stimulus delivered while the bone conduction receiver was moved about at its site of application.

3. Repeated bone conduction threshold tests were carried out at the frontal and mastoid bones. The bone conduction receiver was positioned and repositioned with no greater accuracy than would be expected in a clinical test carried out with reasonable care.

In the first and second methods listed above, difficulties were encountered in that, first, the relative shapes of mastoid processes and the bone conduction receiver often prevented the receiver's being placed firmly in a predetermined position;

second, movement of the bone conduction receiver by as much as 3 cm. at the frontal bone produced little or no apparent change in sensitivity, making it impossible to pick out a "best" or "worst" site. For these reasons the first two methods of examination were discontinued, leaving the method of repeated threshold tests of a general "clinical" standard.

PROCEDURE.

Repeated bone conduction thresholds were carried out on four normal ears over a period of several weeks at both the frontal and mastoid bones. The test tone frequencies examined were the octaves from 125 to 4,000 cps, the threshold of each ear for each frequency being determined at both sites on a total of five separate occasions. No ear was tested at the same site more than once a day, there being an average of one week between similar tests, and care was taken to vary the order in which the tests were performed on each occasion.

A Maico Model C constant pressure type bone conduction receiver, mounted in a suitable headband, was used throughout the tests, and the ear not under investigation was masked by narrow band white noise (delivered by a PDR 10 receiver) at a constant level, giving approximately 30 db masking effects at each frequency. The ear under test was unoccluded, and tests were carried out in a sound treated room. The bone conduction receiver was placed in what would be regarded as a clinically satisfactory position; this position was, on occasion, determined at the mastoid site by the experimenter's ability to place the receiver in such a way that it would remain in place throughout the test. Both the constant pressure type of receiver (used in these tests) and the smaller hearing aid type bone conduction receiver may tend to touch the pinna unless this is pulled forward and held away from the receiver; for this reason, in the tests described, it was occasionally necessary to pull the pinna forward slightly with adhesive tape; clearly no such difficulties obtain when the receiver is applied to the frontal bone.

The thresholds were determined with a Békésy Audiometer (Grason-Stadler type E 800) at discrete frequencies and with

the test tone pulsed (period approximately 400 m sec., rise-fall time 25 m sec. duty cycle 50 per cent).

Each test tone was presented for 30 seconds or until the excursions of the recording pen appeared to be stabilized; a one minute threshold tracing was then taken. This procedure was repeated for each test tone used.

RESULTS.

The procedures outlined resulted in series of threshold measures of each ear treated at each application site and for each frequency. These measures were so grouped that the average test-retest differences observed at the frontal bone

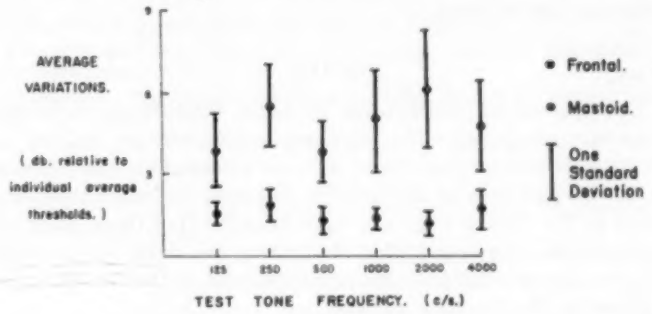

Fig. 1.

could be compared with those observed at the mastoid, each test frequency being treated independently. The average test-retest differences observed at the two sites are illustrated in Fig. 1; clearly the threshold differences were smaller when the bone conduction measurements were made at the frontal bone, the relation being significant at the 0.1 per cent level for each test frequency except 125 c/s where it was significant at the 1 per cent level (see Appendix for details of the method of treatment of results).

The tests in which frontal and mastoid bone conduction thresholds were determined at three pre-selected positions, and the tests carried out at the "best" and "worst" positions

(the first and second methods referred to above) gave results supporting the conclusions described herein. These two test methods were not carried to completion for the reasons given previously.

CONCLUSIONS.

The results obtained indicate clearly that the test-retest reliability of bone conduction threshold tests carried out with the bone conduction receiver applied to the frontal bone is superior to that of similar tests made at the mastoid process. These results are accepted as a practical demonstration supporting the claims of earlier authors who have advocated the use of a frontally-applied bone conduction receiver for clinical bone conduction tests.

SUMMARY.

The test-retest reliabilities of bone conduction threshold tests carried out with the bone conduction receiver applied to the frontal and mastoid bones were determined on four normal ears. Comparison of the results obtained indicates the tests made at the frontal bone are more reliable than those made at the mastoid,—an observation supporting the claim that clinical bone conduction tests should be carried out at the frontal bone and not at the mastoid process.

APPENDIX.

The measures outlined earlier resulted in 48 sets of five bone conduction thresholds, eight for each frequency investigated; (two sets for each of the four ears tested, one being obtained at the frontal bone and one at the mastoid). Averages were determined for each set of five threshold measurements, and the differences of the five members of each set from their "set average" were calculated. This step resulted in 48 groups of five difference figures, 24 (four at each of six frequencies) being obtained from frontal bone and 24 (four at each of six frequencies) being obtained from mastoid bone measures. The 48 groups of five difference figures were then re-divided on the basis of test frequency and of site of bone

conduction receiver application, giving 12 series of difference figures, one for each of six frequencies tested at the frontal bone and one for each six frequencies tested at the mastoid. The members of each of these 12 series of difference figures were pooled and averaged (sign being ignored), a step that resulted in a total of 12 average test-retest values (one for each frequency at the frontal bone and one for each frequency at the mastoid). Deviations from these averages were determined within each of the 12 series of difference figures referred to above; thence Standard Deviations were calculated and the significance of the frontal-mastoid relationships observed was determined (t test).

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THE RELATIVE STABILITY OF HALF-LIST AND FULL-LIST DISCRIMINATION TESTS.

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Chicago, Ill.

One of the more obvious goals of audiologic practice is maximum efficiency in the utilization of time. As evidence, witness the efforts which have been directed toward abbreviating individual and group pure tone testing methods. It has been suggested further that conservation of time may be effected through reduction of that portion of the testing period devoted to the measurement of speech discrimination ability. In this regard, Bowling[1] has written:

> "It might be argued that the factors of time involved and fatigue of patients are negligible, in view of the fact that approximately four minutes is usually enough to present a single list of PB words. This is true, but in many instances discrimination scores must be obtained monaurally and binaurally, under conditions of both quiet and noise. If no complications arise, such as having to present additional lists at greater intensities to be sure of having maximum discrimination score, this operation alone will involve approximately 25 minutes of both tester's and patient's time. This of course, is in addition to time spent obtaining pure tone audiograms and speech reception thresholds required in an audiometric workup. If an evaluation for possible hearing aid usage is included, additional discrimination scores in sound field under conditions of both quiet and noise, must be obtained unaided and with several (three or more) aids. This demands at least 25 additional minutes for determining discrimination scores alone, barring any complications."

Clearly, then, in shortened discrimination tests, the possibility exists for a significant reduction in the expenditure of time per patient, as well as decreased probability of fatigue.

The "traditional" discrimination stimuli have been monosyllabic words arranged in groups of 50, each of which is constructed so that the distribution of phonetic elements within it approximates that of spoken English as a whole. There are apparently two reasons for using 50 words: first, it is a simple matter to convert the number correct or incorrect into a percentage score; second, in his original work on articula-

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tion testing methods, Egan[3] found it impossible to maintain the desired phonetic composition in a group of only 25 words.

In considering any abbreviated discrimination test, the first reason given above is of minor importance and may be disregarded. As for the second, it seems to be the consensus that phonetic balance is not as crucial a factor to the sensitivity of these tests as it was thought to be at the time the original PB-50 lists were developed[7]; therefore, there appears to be no reason for not employing discrimination tests which consume less time, providing it can be shown that the briefer procedures fulfill the same function as the longer, and in a similar manner.

Obviously, the extent to which a 50-word test is shortened, and the manner in which this is done will influence the degree to which the resultant test will approximate its "parent" in function. For example, Breakey[2] had a panel of listeners rank the words in certain of the Harvard PB-50 lists with respect to difficulty. She then administered the 25 most difficult words as a discrimination test, on the assumption that the difficult words are the only ones which really test discrimination ability. Another method was adopted by Shore and Hirsh,[5] who gave 25-word discrimination tests as part of a study designed to check reliability in measures of hearing aid performance. Their method has been described by Shore:[6]

"Words were selected from lists 9B and 10B only and put on tape. From these lists, eight lists of 25 words each were used. For example, one list consisted of the first 25 words of the 9B record, the second list, the remaining 25 words. This procedure was followed for the first four lists. The fifth through the eighth lists consisted of every other word, such as 1-3-5, etc. The major reason for not using the full 50 word lists was the time element."

Bowling,[1] inquiring directly into the relationship between half- and full-list test results, employed the CID W-22 Auditory Tests,[4] which, like the Harvard tests, incorporate 50 words. The series has four master lists, each of which is available on phonograph discs in six different word orders. Bowling presented two consecutive recordings to each test ear and determined the percentage correct for each 25-word segment. In this way, he obtained four estimates of discrimina-

tion ability based upon 25-word lists, and two estimates based upon 50.

Common to all of the studies cited is the fact that 25 words were selected from a group of 50, and then administered to test auditory discrimination ability. Speculation is certainly warranted as to differences which might have arisen between the obtained scores, based on 25 words, and scores which the respective experimental subjects would have made on a 50-word test.

Bowling correlated half- and full-list scores made by 80 subjects, and found coefficients on the order of $r = .95$, indicating a strong association between scores on the two kinds of tests. This is not an illogical result in view of the fact that a common quantity, the 25-word score, was present in both variables being correlated. In fact, it is to be expected that, *regardless of the manner in which the 25 words are chosen,* the correlation between scores on the 25- and 50-word tests will be positive and high, for this same reason. If the strength of this relationship were the only pertinent factor, it would be altogether reasonable to adopt 25-word tests for routine use in audiologic examinations; however, there is at least one other factor to consider—the stability of measurements made with each type of test.

Before abbreviated discrimination tests can legitimately replace those presently in use, it must be shown that they yield scores which are, as a group, at least as stable as those derived from the original tests. It was the purpose of the present investigation to attempt to make some determination as to the general clinical utility of half-list tests, on the basis of their stability relative to that of full-list tests.

PROCEDURE.

Auditory discrimination loss was measured on a large number of adult, male patients who were seen respectively at six Veterans Administration Audiology Clinics. The determinations, in which *recorded* CID W-22 tests were used exclusively, formed part of the routine audiologic examinations performed at these clinics. Data were accumulated on all of the 24 lists

in the W-22 series; however, since individual clinicians were free to employ any list without reference to those being used at other clinics, certain lists were ultimately administered to a small number of patients. After these were eliminated, only nine lists and N = 581 remained. The distribution of the samples by list and by Veterans Administration clinic appears in Table I.

TABLE I.

Distribution of Patients by W-22 List and by Veterans Administration Station at which They Were Tested.

	VA Audiology Clinic.						
W-22 List	Chicago	Dallas	Wash.	L. A.	N. Y.	S. F.	Total No. by List
1-C	74	–	–	–	–	–	74
1-D	72	–	–	–	–	–	72
1-F	–	14	3	5	24	12	58
2-B	–	24	–	–	13	11	48
2-C	–	–	15	20	22	–	57
2-D	–	32	1	12	4	–	49
3-B	42	5	8	13	–	1	69
3-F	57	4	–	–	–	1	62
4-A	92	–	–	–	–	–	92
Total No. by Clinic	337	79	27	50	63	25	581

In accordance with usual procedures, one recorded W-22 list was presented to one ear, and another to the opposite ear of each patient. During each test, the following data were noted: *a.* number of words missed out of the first 25 words, *b.* number missed out of the second 25 words, and *c.*, the sum of these two. Only those results yielded by the better ear were utilized in this study. There were, thus, three estimates of discrimination ability for every patient receiving each test: two based on half-lists (25 words), and one based on a full-list (50 words). The hypothesis to be tested was that of no difference in stability between series of half-list and full-list scores generated by patients subjected to identical tests.

The standard deviation was adopted as the index of stability, and the assessment of differences was based upon a comparison of standard deviations. Initially, it was proposed to apply

TABLE II.

Mean Discrimination Loss, Standard Deviation (σ), and Standard Error of the Standard Deviation (σ_σ) Yielded by Independent Samples Nine CID W-22 Auditory Tests. All Calculations Are Rounded to the Nearest Whole Number.

W-22 Test		Mean Discrimination Loss in Per Cent	σ in Per Cent	σ_σ in Per Cent
1-C	First half	16	14	1
	Second half	15	12	1
	Total	15	12	1
1-D	First half	15	13	1
	Second half	16	13	1
	Total	15	13	1
1-F	First half	15	16	1
	Second half	14	16	1
	Total	15	15	1
2-B	First half	17	19	2
	Second half	22	20	2
	Total	20	19	2
2-C	First half	12	12	1
	Second half	11	10	1
	Total	11	10	1
2-D	First half	12	15	1
	Second half	14	18	1
	Total	13	16	1
3-B	First half	19	21	2
	Second half	21	22	2
	Total	20	21	2
3-F	First half	19	22	2
	Second half	19	22	2
	Total	19	22	2
4-A	First half	22	20	1
	Second half	21	19	1
	Total	21	19	1

statistical tests to this comparison, but, as will be shown in the following section, this became unnecessary in view of the minimal differences actually found.

RESULTS AND CONCLUSIONS.

Table II shows the mean discrimination loss, standard deviation (σ), and standard error of the standard deviation (σ_σ) for half-list and full-list results on nine tests in the W-22 series. All calculations are in percentage terms and are rounded to the nearest whole number.

It is immediately apparent upon inspection of this table, that the greatest difference on any test between half- and

full-list σ's is 2 per cent, or less. This is equivalent to one word on a 50-word test, or one-half of one word on a 25-word test. Considered with the excellent correlation between the two types of scores, this would tend to support the notion that the use of abbreviated discrimination tests, as described in this paper, is justified.

Further support derives from the fact that *a.* σ_σ is, in all cases, less than 2 per cent, and, in most, less than 1 per cent; and *b.*, in no instance does σ_σ half-list exceed σ_σ full-list. It is beyond the scope of this paper to treat the obvious disparities among the means of the several tests; the important fact is that, with but one exception, the half-list means do not depart from their full-list counterparts by more than 1 per cent.

There is little reason to believe that, if an evaluation similar to the foregoing were carried out with other groups of patients and other W-22 lists, the results would differ appreciably from those reported. It is concluded, therefore, that either the first half or the second half of any test in the CID W-22 series may be administered in lieu of the full, 50-word test, with the assurance that the resultant discrimination score will, in the long run, differ only minimally from that which would have been obtained using the full test.

The writer is indebted to the chiefs and audiological staffs of the following Veterans Administration stations, for their cooperation: VAH Chicago, VAH Dallas, VBO Washington, D. C., VARO New York City, VARO Los Angeles, VAH San Francisco.

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820 S. Damen Avenue.

VIIeme INTERNATIONAL CONGRESS OF OTOLOGY, RHINOLOGY AND LARYNGOLOGY.

The Seventh International Congress of Otology, Rhinology and Laryngology will be held in Paris, July 23-29, 1961, at the New Faculte of Medicine, Rue des Saints-Peres. The program includes *1.* The Recent Acquisitions, Pathology and Therapeutics of Otosclerosis by Profs. Sourdille, Sercer and Krmpotic, Weber, Ardouin, Larroude, Ferreri and Shambaugh. *2.* Indications and Five-Year Results in Surgery and Radium in the Treatment of Cancers of the Larynx and Hypopharynx—Profs. Pietrantoni and Agazzi Alonzo, Casadesus, C. L. Jackson, Leicher, Leroux-Robert and Ormerod. *3.* A Report on Allergy and Infections of the Nose and Bronchus—Profs. Van Dishoeck, Clerici, Hlavacek, Voohorst, Mayer, Laskiewicz and Terracol.

Tours and entertainment for guests and their ladies have been arranged. President: Dr. Maurice Aubry; Secretary General: Henry Guillon. For further details write Dr. Guillon, 6 Avenue McMahon, Paris, France.

VOCAL THERAPY FOR CONTACT ULCER OF THE LARYNX. A FOLLOW-UP OF 70 PATIENTS.*†

GEORGIANA M. PEACHER, Ph.D.,

Philadelphia, Pa.

One hundred and one patients with contact ulcer had been given vocal therapy in a 12-year period. Due to the frequent recurrence of this ulcer before vocal therapy was introduced, it seemed necessary to determine the condition of the larynx and voice in these patients in the years following therapy. Follow-up was possible for 70.

Vocal therapy for contact ulcer was reported first by Peacher and Holinger.[1] That study included a control group of ten patients who had not received therapy and an experimental group of six who had received it. Results showed healing of the ulcers in the experimental group during therapy and recurrences in seven of the control group where surgical excision and silence alone were used. The present study includes a follow-up of the six patients in the experimental group.

STATUS OF THE LARYNX AFTER THERAPY.

Sixty-five patients had no recurrence of contact ulcer in one to 12 years following vocal therapy. Five had one recurrence each. Fig. 1 indicates the number of years following therapy in which the 65 had no recurrence. The original six patients whose ulcers healed on an experimental basis had no recurrence in 12 years. This denoted that 93 per cent had no recurrence. Of these, one developed malignancy under the vocal cord opposite the site of the ulcer nine years after therapy. Laryngofissure was performed, and two years later, total laryngectomy was necessary. He developed an unusually pleasing esophageal voice, the quality of which closely re-

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*Presented at the Seventh Pan American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology, Miami Beach, Fla., March 22, 1960.

†From the Chevalier Jackson Clinic, Temple University Medical Center.

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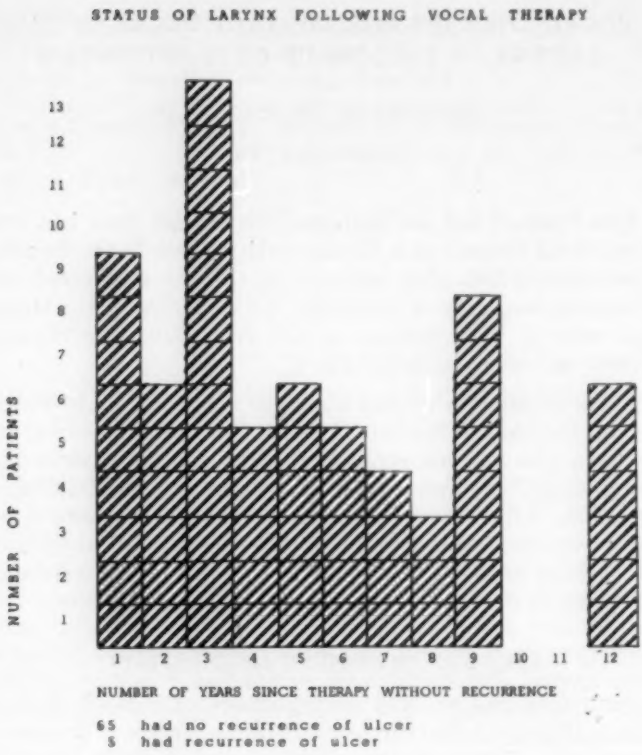

Fig. 1.

sembles his former voice, and he returned to preaching. Previously he had had a vocal nodule and was the only one in this group who had had laryngeal pathology other than contact ulcer.

LENGTH OF TIME FOR HEALING OF THE ULCER.

The healing time was taken as an index of progress. A wide variation existed. Fig. 2 demonstrates details. Healing time varied from one week to five years. It was uncommon, however, to take as little time as one to three weeks or as long as

one to five years. The major number of 46 patients or 66 per cent healed between one and three months.

The following factors were investigated to determine this variability: operative and nonoperative groups. The question of operation for contact ulcer was analyzed. Thirty-four patients had 80 operations before and during therapy. Thirty-

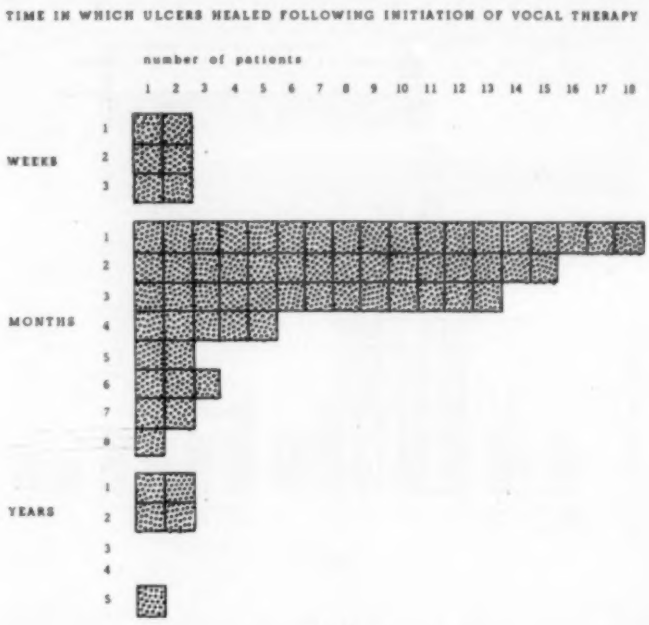

Fig. 2.

six had no operations. Those with operations had an average healing time of 26.52 weeks or six-and-a-half months. Those with no operations had an average healing time of 10.05 weeks or two-and-a-half months. It appeared significant that those without operations healed at a faster rate than those with operations. Fig. 3 shows the distribution. While there are exceptions in each group, the over-all picture reveals those

with operations are weighted more toward the longer healing groups and those without operations tend to the direction of the faster healing groups.

Number of Operations Per Patient. The number of operations for each patient relative to healing time was examined. The results in Fig. 4 reveal the greater number of surgical

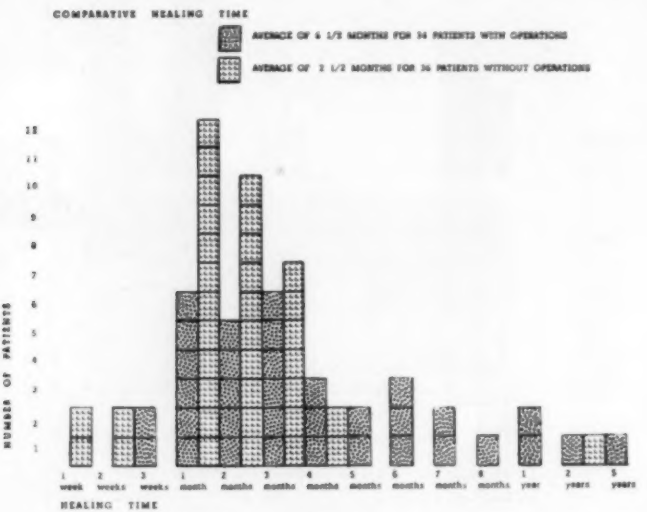

Fig. 3.

excisions, the longer the healing process. There was a steady increase in numbers of operations as the time increased from an average of one operation in the group healing in one to three weeks, to an average of 4.75 operations in the one to five-year group. Regarding these last two significant findings, the size of the ulcer and presence of granuloma were questioned. It could be conjectured that the larger ulcers take longer to heal. I do not know whether or not this is true, as complete data were not available for all patients. This is a study which needs research with photographs and exact di-

mensions at the first and subsequent laryngoscopic examinations.

It is our belief that surgery is necessary only with massive ulcers in the presence of large granulomas and advisable before therapy. This accounted for some of the surgery performed once. There were several who had small granulomas

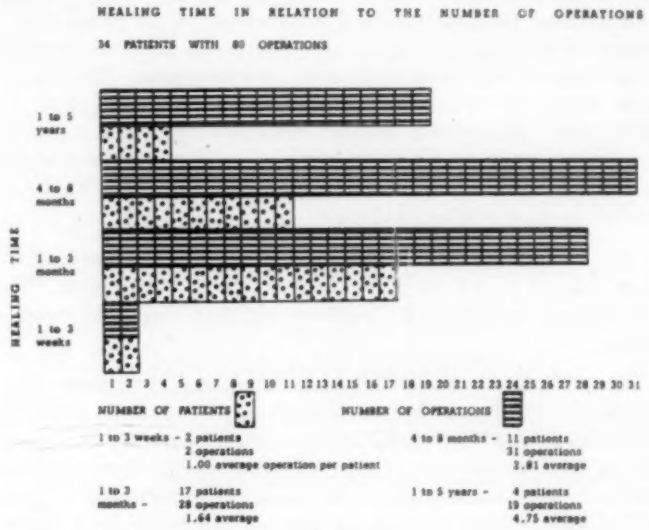

Fig. 4.

which were not removed and healed in one week to three months. There were two known small ulcers in the one to five-year healing group.

Emotional Element. Another factor, the emotional aspect, seemed to be important in healing time. Most patients who come for a laryngeal examination have some concern. The majority lose concern when the nature of their problem is explained. Those in whom healing required longer time, continued to be concerned. As time went on and as further operations were performed, the anxiety increased. The num-

ber of operations and amount of concern appeared to be mutually connected.

Length of Therapy. The length of therapy in relation to healing time showed no significance. The average hours' treatment was from 5.6 to 8.0 hours for the various groups.

Concentrated or Expanded Treatment. Another factor examined was the manner in which the therapy was presented. Twenty-nine patients received an average of 7.6 hours over a period of two to eight months. Forty-one patients received an average of 6.9 hours within one to two weeks. The former were those who lived within commuting distance, and the latter were those from greater distances who had come for concentrated treatment. When these groups were correlated with length of healing time, both were evenly distributed and, therefore, no significance found.

Age. The age span of these patients at the onset of the ulcer was 27 to 69 with an average age of 45.5 years. The distribution indicated no relation between age and healing time.

Other Factors. No correlation in healing time was determined for other factors including sex, occupation, smoking, drinking, time of difficulty prior to treatment, use of silence, and ability to carry a tune. There were 68 men and two women. Most were engaged in speaking professions. Those who smoked were advised to stop at the time their ulcers were diagnosed. There were nine who continued to smoke, but moderately. Thirty-two had never smoked. Twenty-nine gave up smoking. There were 36 who drank alcoholic beverages and 34 who did not.

STATUS OF VOICE AFTER THERAPY.

Quality. Prior to therapy most patients had some degree of hoarseness. There were 39 who had had consistent hoarseness from a mild to severe degree. There were 15 who had had hoarseness only at the lower pitches of their speaking range while the middle and upper pitches remained clear. There were ten who experienced hoarseness after speaking

a while. There were six who had had no hoarseness. After therapy, 61 had consistently clear voices. Two had slight hoarseness. Six had occasional hoarseness. One had esophageal voice. The two patients with persistent hoarseness had had operations. For the six who had occasional hoarseness, five had received operations and one had not.

Vocal Fatigue. Most patients had felt varying degrees of vocal fatigue prior to therapy. It differed from slight tension

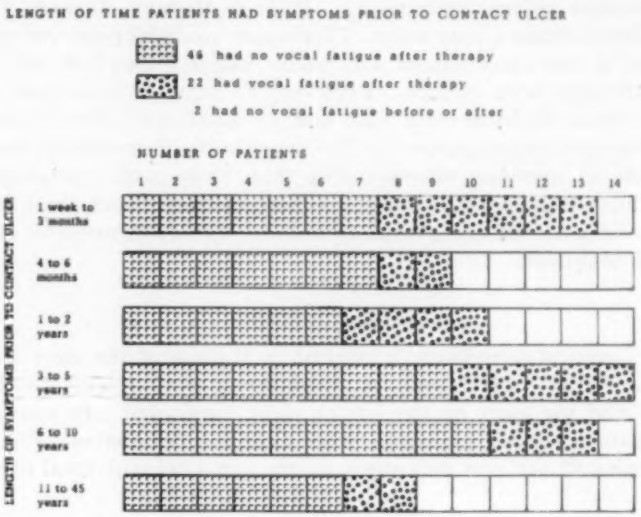

Fig. 5.

to soreness or pain in the throat during phonation. There were 68 who had had vocal fatigue and two who had not. Following therapy, 48 had no vocal fatigue, and 22 experienced discomfort during phonation on certain occasions. The latter, however, stated that these times were rare in comparison to their frequent occurrences prior to treatment and also less severe. They utilized the beginning of fatigue as a warning, ceased talking as much, and within a span of minutes, hours or overnight, the symptom disappeared.

The group without operations had not experienced as much vocal fatigue in the years after therapy as those with operations. Of those without operations, 30 had no fatigue and six did. For those with operations, 18 had none and 16 did. This symptom had been present in 68 patients intermittently or persistently for one week to 45 years prior to diagnosis of contact ulcer. Fig. 5 indicates the distribution and also specifies those 22 in which it persisted.

Use of Volume. Another symptom concerned the ability to increase volume or intensity. Prior to therapy, 29 were unable to obtain a loud voice. Thirty-nine could increase volume, but it was accompanied with vocal fatigue. Two had had no difficulty with volume. Following therapy, 53 were able to increase loudness with ease and 17 could not. Four stated they had not attempted it. The group without operations were able to increase volume better than those with operations. Thirty-four without operations could increase volume and two could not. Of those with operations, 19 could increase, and 15 could not.

CEREBRAL DOMINANCE.

Cerebral dominance in relation to the site of the ulcer was calculated. Right and left handedness were related to the site of the ulcer on the left or right vocal cord. In case of bilateral contact ulcer, the larger ulcer was designated. Fig. 6 shows 83 per cent had ulcers on the non-dominant vocal cord.

ETIOLOGY.

It is felt that contact ulcer has a dual causation: vocal abuse and emotional tension. The abuses to the vocal cords were as follows: glottal plosive attacks, pitch lower than normal, poor breath control, excessive throat clearing or coughing, and overuse of the voice. Von Leden and Moore[2] have demonstrated the damaging effect of the glottal plosive attacks, pitch lower than optimity and throat clearing with ultra-high speed cinematographic research.

The second cause appeared to be emotional. This does not mean necessarily that it is a neurotic manifestation. Con-

trarily, most were exceptional in their adjustment to life and in their work and home satisfaction. They led well-organized lives and were highly successful in their work. In contrast to the laryngectomized patients who are seen frequently in clinic and in wards, only one of this total group of 101 was seen in clinic.

Common in the histories of the contact ulcer group was an

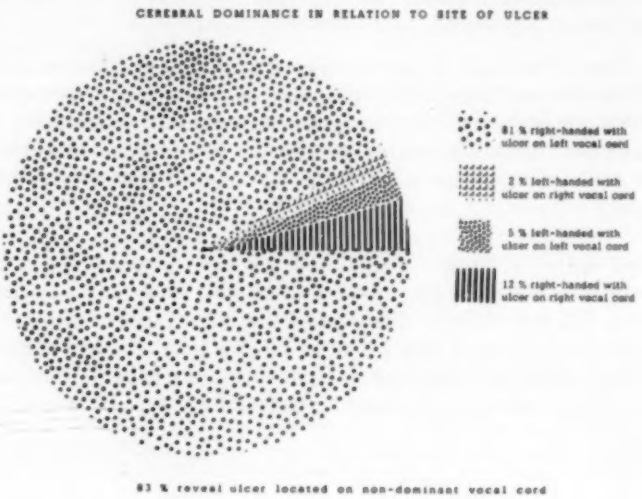

Fig. 6.

emotionally charged incident, series of events or pressure. These revolved about a working situation.

TREATMENT.

Surgery. Because the 36 patients without operations apparently faired better than the 34 with operations, it seems wise to operate only with massive ulcers in the presence of large granulomas. This is advisable before vocal therapy.

Psychotherapy. Psychotherapy is felt necessary only with a minority of these patients. Reassurance that it was not a

severe condition, and that many have overcome ulcers and returned to full use of voice, was sufficient to most. Full explanation of the entire problem is helpful to the new patient's understanding his condition and in lessening his anxiety. Showing charts and ultra-high speed movies of vocal cord action have been helpful. This is an educative, superficial type of psychotherapy rather than dynamic psychoanalytic therapy where childhood experiences are related to patterns of adult behavior, and the unconscious is revealed to resolve conflicts.

Vocal Therapy. Vocal therapy remains the treatment benefiting the majority. Holinger and Johnson[3] stated that teamwork between the laryngologist and speech pathologist is essential; they also recommended the elimination of sources of oral infection, as oral sepsis was one of the factors they found responsible for the chronicity. Vocal therapy included the establishment of a pitch one to five full tones above the used speaking range. When hoarseness is present, the pitch naturally descends and must be brought back to its normal level, but not higher. The glottal plosive attacks of the vocal cords are removed and replaced by the normal, easy attack. Easy abdominal breathing and phonation are given. Increase in volume with ease is taught, perferably after the ulcer has healed.

CONCLUSIONS AND SUMMARY.

A follow-up study of 70 patients who had received vocal therapy for contact ulcer was presented to determine the condition of larynx and voice in subsequent years.

Sixty-five had no recurrences of ulcers and five did. Sixty-one had consistently clear voices, two had slight hoarseness, six had occasional hoarseness, and one had esophageal voice. Twenty-two had occasional vocal fatigue.

Factors relating to the length of time the ulcers healed were investigated. It appeared significant that 34 patients with operations healed on the average of six-and-a-half months while the 36 without operations healed on the average of two-and-a-half months. An emotional factor also appeared

to account for some of those whose ulcers took longer in healing. Those without surgery were appreciably less symptomatic in terms of hoarseness and vocal fatigue than those with surgery.

Etiologically, it is felt that contact ulcer is due to vocal abuse over a long period of time with breakdown at a finite time of extra emotional tension in work.

Treatment consists of surgery only with massive ulcers in the presence of large granulomas and performed prior to vocal therapy.

Dynamic psychotherapy from a psychiatrist is recommended for a minor number. Superficial psychotherapy of reassurance and educative knowledge of the condition are sufficient for most.

Vocal therapy is recommended for all to relieve the irritating ways of phonation which harm the vocal cords and impair the voice.

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IDIOPATHIC HEMOTYMPANUM—A NEW APPROACH.

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Idiopathic hemotympanum was first recognized as a clinical entity by Shambaugh[1] in 1929. A total of 20 proven cases has been reported since that time with the cause and successful treatment of this entity still in doubt.

A number of clinical features evolve from surveying these cases. The following symptoms are commonly present: *1.* Pain or discomfort in the affected ear. *2.* Conductive type hearing loss. *3.* Occasional episodes of aural discharge.

Upon examination the tympanic membrane has a dark blue color and has little or no motion when tested by a Siegel pneumatoscope. This blue color is not the faint "gun metal" blue seen in serous otitis media as stressed by Sheehy and McKibben.[2] The Eustachian tube is usually patent when tested by politzerization. Mastoid roentgenograms show diffuse clouding of the mastoid cells regardless of whether or not the mastoid bone is of the pneumatic type.

Laboratory examination of the brownish-red fluid obtained shows it to be sterile. Suspended in this fluid are moderate numbers of red and white blood cells suggesting a hematogenous origin of the fluid.

The treatment of idiopathic hemotympanum has drastically changed during the past 30 years. Shambaugh,[1] in his original report described his failure to maintain normal hearing despite repeated myringotomies and inflation of the Eustachian tube. Hearing was improved for several days until the myringotomy opening closed. Menck-Thygesen[3] also reported only brief and fleeting improvement after myringotomy and

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Eustachian tube inflation. In 1949 Ranger[1] performed a simple mastoidectomy on a child and also on a young adult with marked improvement in hearing in both cases. Since then, Sheehy and McKibben[2] have presented three cases of idiopathic hemotympanum upon which a mastoidectomy was performed. They obtained a good result in one case, a moder-

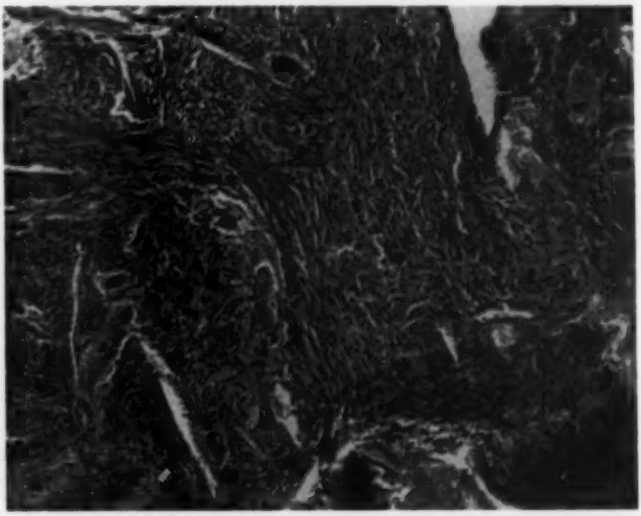

Fig. 1. Tissue from mastoid cells showing cholesterol clefts, multinucleated giant cells and fibrous connective tissue.

ate conductive loss of 36 decibels in another, and failure in the third patient.

The following is a case report of idiopathic hemotympanum which has remained free from pain and aural discharge while maintaining normal hearing for the past six months.

CASE REPORT.

A 20-year-old student was first seen in the Palo Alto Medical Clinic complaining of recurrent pain and bloody discharge from the left ear. As long as he could remember he had never been able to hear with the left ear. At the age of eight he had an adenotonsillectomy to remedy this condition, but no improvement followed this procedure. Through-

out his childhood and young adult life he had been troubled with pain and pressure in the left ear followed by intermittent dark brown fluid draining from it.

Examination revealed the nasopharynx to be relatively free of adenoid tissue. The right ear was normal. The left external auditory canal had dried bloody crusts and debris present. When this was removed an intact tympanic membrane was seen appearing dark blue and retracted. An audiogram demonstrated a relatively flat conductive hearing loss of 35 decibels with normal bone conduction.

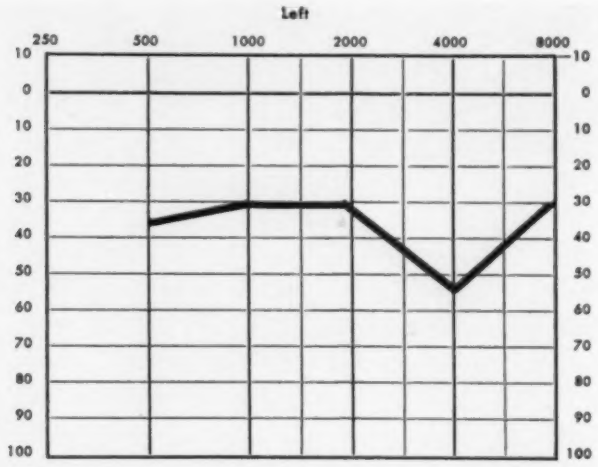

Fig. 2. Hearing level by air conduction prior to insertion of polyethylene tube.

Roentgenograms showed a diffusely sclerotic mastoid with a suggestion of a radiolucent area in the region of the antrum.

On September 2, 1959, a simple mastoidectomy was performed. Brownish-red material filled the mastoid cells including the zygomatic and squamosal cells. It had the consistency of granulation tissue. The antrum and middle ear regions were free from this granulation-like tissue.

Microscopic examination of this tissue revealed "dense cellular fibrous connective tissue containing numerous cholesterol crystal clefts, a few multinucleated giant cells and several large focal aggregations of hemosidirin-laden macrophages (see Fig. 1).

The postoperative course was uneventful and his hearing was improved; however, upon examination 12 days postoperatively an audiogram showed the hearing again to be at 35 decibels (see Fig. 2).

On November 24, 1959, a paracentesis by sterile technique was done. About .5 cubic centimeters of brownish-red fluid were aspirated, and laboratory examination showed this to be sterile with 100-200 red blood

cells and 4-6 white blood cells per high power field. Vanden Berge test was positive for occult blood.

On December 2, 1959, a polyethylene tube, No. 90, was inserted into the middle ear through an incision in the tympanic membrane, using xylocaine infiltration of external meatal skin. The hearing was immediately normal (see Fig. 3).

In the following weeks no aural discharge was noted by the patient, and only a small semilunar-shaped crust was present just external to the tympanic membrane. The hearing has remained normal throughout

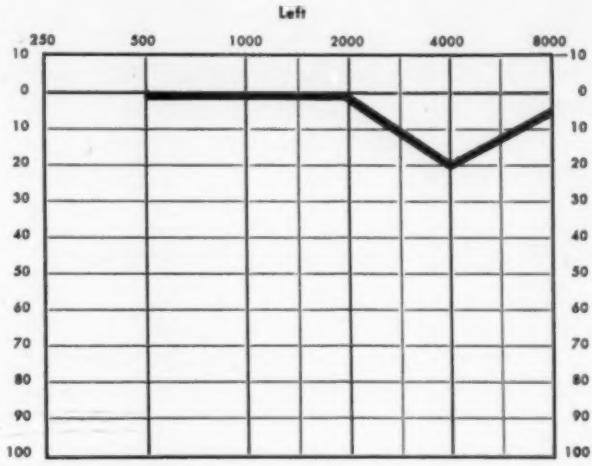

Fig. 3. Hearing level by air conduction after insertion of polyethylene tube.

the entire time since then except on one occasion when the tubing became dislodged.

COMMENT.

In spite of numerous and thorough examinations of the mastoid cells by careful observers[2,4,5,6,7,8,9] during the past 30 years, the cause of this condition remains obscure. Sheehy and McKibben[2] place the origin of bleeding in the mastoid cells; Birrell[5] raises the possibility of a viral etiology.

Microscopically, the tissue obtained in the case in which a mastoidectomy had been performed is probably the result of

bleeding rather than the source of this middle ear effusion. Essentially, this tissue is organizing blood elements such as red and white blood cells enmeshed in connective tissue strands; also always present are macrophages and giant cells, indicating an attempt of the body to remove these products of blood disintegration.

The symptoms of pain and conductive type hearing loss as a result of the retained fluid are of primary concern to the patient. Previously, the numerous and varied surgical procedures have neither aided in the search for the etiology of this condition nor proved satisfactory in relieving the patient of his distressing symptoms.

More frequently today the presence of recurrent serous otitis media is being reported which does not respond to adenotonsillectomy, myringotomy and aspiration. Armstrong[10] has shown the value of using polyethylene tubing in these stubborn cases for proper ventilation of the middle ear.

The use of polyethylene tubing in the above case has been effective in restoring the hearing and relieving the annoying symptoms. After insertion of the tubing, the patient experienced no pain or discomfort from it. The hearing was normal for the longest period in his life that he could remember.

The various causes of a blue eardrum other than idiopathic hemotympanum should be remembered and ruled out before a myringotomy and polyethylene tube insertion is performed. Among those encountered in the literature are glomus jugulare tumor, protrusion of the jugular bulb, closed head injury,[11] hemangioma of the middle ear, hemorrhagic diathesis, varices of the middle ear[12] and allergic conditions.

If a complete evaluation of the ear, nose and throat system including a physical examination, pertinent laboratory studies, mastoid roentgenograms and audiometric evaluation has been done, it would seem feasible to view the middle ear region under direct vision. An exploratory tympanotomy under local anesthesia would provide an opportunity to inspect the middle ear region to rule out neoplastic processes or vascular anoma-

lies prior to insertion of the polyethylene tube. This would eliminate the more extensive procedure of mastoidectomy with its inconsistent results in this condition.

CONCLUSION.

The condition of idiopathic hemotympanum is an established clinical entity. While the cause remains obscure, it may be analogous to chronic secretory otitis media and respond to proper ventilation of the middle ear. A thorough examination including directly visualizing the middle ear should precede the insertion of polyethylene tubing. If this method is followed there is every reason to believe that the patient's distressing symptoms can be relieved and the hearing restored.

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ORAL DECONGESTANTS.

A Double Blind Comparison Study of the Effectiveness of Four Sympathomimetic Drugs: Objective and Subjective.*†

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Orally administered sympathomimetic amines for the relief of nasal congestion have taken a prominent position in the medical armamentarium of the physician in the last five years. In compounded preparations or alone, they are readily used in the general treatment and relief of the nasal congestion in acute and subacute rhinitis, acute and subacute sinusitis, vasomotor rhinitis, and allergic rhinitis. Proetz,[1] Brown and Goodhill,[2] Fabricant,[3] Stough,[4] Walsh,[5] and others have expressed confidence in them.

The advantage of these oral decongestants seems to rest in their ability to act upon all the nasal and sinus mucosa, providing more adequate aeration and drainage of the sinuses than the conventional topical administration.

In our clinical application, a clear picture of the actual degrees of nasal decongestion by the sympathomimetic amine action alone has been prevented by the compounded commercial preparations which contain antihistamines, expectorants, antitussives, antipyretics, analgesics and steroids. The concomitant use of antibiotics, the improving tendency of an acute illness and, of course, the placebo effects of any treatment have all contributed to arousing our curiosity as to the

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actual degree of the effects of the oral decongestant. We have hereby undertaken a study to clarify the role played by the oral decongestant alone. The drugs and dosages used in this study are:

Ephedrine Sulfate (Ephedrine) 25 mg.

Pseudoephedrine HCL (Sudafed) 60 mg.

Phenylephrine HCL (Neosynephrine) 10 mg.

Phenylpropanolamine HCL (Propadrine) 25 mg.

This has not been an easy project. One has but to delve into Proetz's[1] treatise on the physiology of the nose, and Modell and Houde's[6] summary of factors influencing the clinical evaluation of drugs, to comprehend the problems to be controlled for a valid study. We have attempted to keep the extraneous influences, such as psyche, temperature, humidity and infection as constant as possible, and collected the data at the time of each test. The multitude of extraneous and prejudicial factors changing constantly the vascular volume of the nasal mucosa (and hence nasal passage size) are also equalized by the process of randomization and by the control of double blindness; however, we are aware that the weight of these factors decreases the sensitivity of our method.

Animal studies by Aviado, et al.,[7] produced some interesting findings when using the sympathomimetic drugs on anesthetized dogs, and measuring the nasal passage resistance to air flow and the degree of carotid constriction. Most of the drugs caused significant nasal decongestion and carotid vasoconstriction. They found that the Ephedrine effects implied relatively more carotid vasoconstriction than nasal decongestion and that Pseudoephedrine produced an intensity of nasal decongestion that more nearly paralleled the intensity of carotid vasoconstriction. Phenylpropanolamine in some tests showed an opposite directional change of both nasal decongestion and carotid vasoconstriction. Phenylephrine was included in the group that produced more frequently the nasal decongestion; Ephedrine and Phenylpropanolamine less so; and Pseudoephedrine occasionally overlapped both extremes

of nasal and carotid vasoconstriction. Their most significant observation throughout their tests was the difference in sensitivity of the nasal vessels from the other branches of the carotid artery. Propadrine, particularly, in some tests showed a paradoxical increased nasal pressure while carotid constriction was present. With the above in mind, we certainly were anxious to see our results on humans.

PURPOSE.

The specific goals of our study have been to ascertain:

1. How much blood pressure change takes place and how the heart rate is affected.

2. The subjective response to the therapeutic effects.

3. What notable side effects occur subjectively at office treatment and at bedtime.

4. How much rhinometric nasal airway improvement occurs from each of four well known sympathomimetic amines as compared to a placebo as well as to each other.

5. How close the subjective declaration of therapeutic effects correlates with these findings.

METHOD.

In this study we have used 88 individuals presenting with the chief complaint of nasal obstruction, and the clinical findings that confirmed a soft tissue congestion and edema. The diagnoses include acute coryza, acute and chronic sinusitis, allergic or vasomotor rhinitis, and hypothyroidism.[5] In a double blind study, each individual was treated with a placebo and four different sympathomimetic amines perorally (440 visits). Immediately before taking the capsule on an empty stomach, the pulse and blood pressure were taken and the total nasal airway resistance measured by McLaurin's[9] rhinometric method, expressed in mm. of water. Sixty minutes later these were repeated and the patient questioned as to: (a) what change had occurred in the nasal airway and whether nervousness or other symptoms were apparent. He was

instructed to take the same capsule 60 minutes prior to retiring at home (5-6 hours later) and to record the next day whether his nasal airway improved before falling asleep and whether any restlessness or insomnia had occurred. For reasons of cooperation and valid answers, only adults were used.

The medications employed were coded and remained so until the tests and statistical analysis were completed. Opaque gelatin capsules were identical to the investigator and patient. Beginning with 130 patients, the number was reduced to 88 for various reasons, usually because of failure to return

Blood Pressure Effects.

Systolic Changes	A	B	C	D	E
20 mm. or more Increase	11 (40)	7 (35)	1 (30)	14 (45)	5 (25)
All types Increase	25	35	18	31	27
All Decreases	42	33	29	18	24
No Changes	21	20	41	39	37

Fig. 1. Totals of patients with categorized blood pressure effects for each drug. Drug A is Placebo; B is Pseudoephedrine; C is Phenylephrine; D is Phenylpropanolamine; E is Ephedrine. Number in parentheses is the single highest increase in mm. of mercury.

for the complete series of comparison tests. For each patient, a separate test was done on each day of the week for five days (Monday - Friday), so as to measure the patient during the same respiratory infection or allergic episode, and to facilitate continuity of cooperation.

FINDINGS.

1. Blood Pressure Tabulations (see Fig. 1) did not provide any markedly significant findings. Phenylpropanolamine caused more rises in systolic pressure, 20 mm. or over, than the others, but the placebo provided almost as many. Pseudoephedrine and Phenylpropanolamine showed more cases with "any amount" systolic rise. Placebo and Pseudoephedrine provided more cases with decreased systolic pressure. Phenylephrine and Phenylpropanolamine had more cases with "no change." Statistical analysis found no evidence of any effects of these drug dosages (and placebo) on the systolic

pressure. There may be some inference that the four drugs maintained the pre-treatment pressure, while the placebo allowed it to drop at the one hour post-treatment testing when the patient was more "at ease."

Heart Rate Observations (see Fig. 2) were similar to the blood pressure. The placebo shows more cases with a decreased rate. The only other divergent figure is Phenylephrine showing more cases with a rate increase of more

Heart Rate Changes.

Total Cases with Rate Changes	A	B	C	D	E
10 mm. or more increase	3 (16)	5 (35)	9 (20)	3 (16)	3 (24)
Any amount increase	23	32	27	30	31
All decreases	41	29	39	30	27
No changes	24	27	22	28	30

Fig. 2. Totals of patients with different heart rate changes. Number in parentheses is the single highest increase in rate.

Clinic Airway Changes.

Clinic Airway Changes Totals - Subjective	A	B	C	D	E
Improvement (all grades)	53	48	38	53	53
Slight	24	19	12	18	18
Moderate	16	15	15	14	14
Marked	11	12	8	16	16
Extreme	2	2	3	5	5
Worse	3	0	2	0	0
No change	32	40	48	35	35

Fig. 3. Tabulation of subjective declarations of changes in airway at clinic testing.

than ten per minute. Statistical analysis found no conclusive evidence of any effect from the drugs.

2. Subjective Airway Change Observations at Clinic Tests (see Fig. 3) show Phenylephrine to be the least effective. The other three drugs and placebo findings are not significantly different. When subjected to statistical analysis, the impression is drawn that none of the treatments is more effective than the placebo.

Subjective Airway Change Observations at "Bedtime" (see Fig. 4) when examined grossly and by statistical analysis

implied none of the drugs were more effective than the placebo.

3. Side Effects were as noted in Fig. 5. When directly questioned as to notable "nervousness," Ephedrine followed by Pseudoephedrine was found to be noted as a producer of "nervousness" by the patient, at the clinic as well as at bedtime. Consistently more complaints were noted at the bedtime testing than at the clinic test, except for the placebo.

Bedtime Airway Changes.

Bedtime Airway Changes Totals - Subjective	A	B	C	D	E
Improvement (all grades)	59	60	58	56	60
Slight	10	10	15	16	23
Moderate	23	28	24	22	22
Marked	22	17	18	15	13
Extreme	4	5	1	3	2
Worse	2	2	4	1	0
No change	27	26	26	31	28

Fig. 4. Tabulation of subjective declarations of changes in airway with bedtime medication.

Nervousness.

	A	B	C	D	E
Clinic Testing	9	3	4	2	7
At Bedtime	7	17	10	8	20
Total Both Tests	16	20	14	10	27
Nervousness %	42	53	37	26	71

Fig. 5. Tabulations of answers of 38 cases when questioned as to "nervousness" 60 minutes after taking oral medication.

Volunteered Complaints are seen (see Fig. 6). Headache and nausea occurred somewhat with all the drugs and grossly appears to be as frequent as a random population. No conclusions can be made from the complaint "dizzy" or "lightheaded," particularly when more frequent with the placebo. The relatively large number of "drowsy" cases with the placebo might infer the lack of C.N.S. stimulation. The remainder of the complaints contributed very little.

4. Rhinometric Evaluation of Response to Treatment.

The data on pre-treatment and post-treatment rhinometric measurement were analyzed by correlation methods (see Fig. 7) to determine the linear least squares regression line and

Side Effects.

	A	B	C	D	E
Headache	11	9	6	4	4
Nausea	5	4	8	2	2
Dizzy and Light-headed	10	3	5	3	1
Drowsy	9	1	2	1	
Dry Mouth	1				1
Urticaria or Hives	1		1	1	
Awoke with Headache	1		1	1	
Awoke with Blocked Nose			1		
Short of Breath		1			
Palpitation			1		
Angina	1				
Asthma				1	
Dysphagia			1		
Tinnitus	2	1			
Headache Improved			1		
Sneezing Paroxysm			1		
Cough Improved			1		
Rhinorrhea	1				
Sore Throat		1			
Weak	1				
"Mood" Improved	1				
Hot Flashes		1			

Fig. 6. Tabulations of "volunteered" side effects of each drug on 88 patients. Numbers are total number of times that symptom was noted for each drug.

Rhinometric Evaluations.

Treatment	Pre-treatment Mean (mm. H_2O)	Post-treatment Mean (mm. H_2O)	t^2	Slope of Regression Line	Correlation Coefficient
A	20.40	19.89	0.02	.95	.56
B	18.53	17.18	0.33	.52	.55
C	24.38	21.45	0.42	.68	.75
D	19.03	19.88	0.03	.41	.30
E	20.25	12.53	6.61 (Significant at 5% level of significance)	.41	.69

Fig. 7. Correlation values of rhinometric differences between means of pre- vs. post-treatment for five treatments.

to make comparative analyses of the slopes of these lines. The results indicate that the slopes of the regression lines are not significantly different. The regression statistics are greatly affected by the extreme variance apparently associated with higher levels of measurement.

Examination of the correlation coefficient in each treatment indicates that a large portion of the total variation involved remains unexplained. This probably is due to lack of

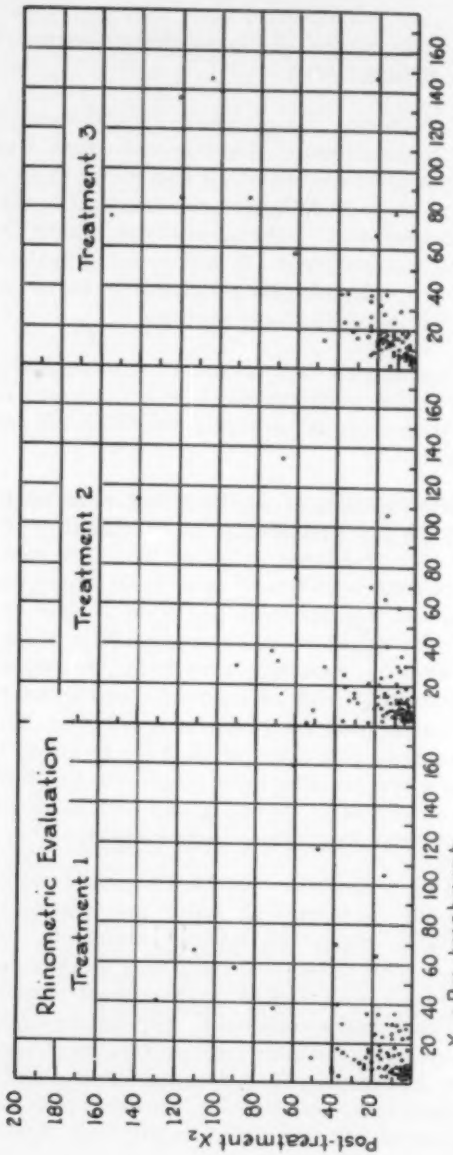
adequate control of overwhelming extraneous factors during the different tests.

Considering the geometric arrangement of points (see Fig. 8), a consistently effective treatment would show all the points to lie underneath a line rising at an angle of 45° from zero. A point falling above that line would indicate that the post-treatment measurement was higher than the pre-treatment measurement. It will be noted in the scattergrams that in each case, excepting Ephedrine, there are a large number of points falling above that line.

Considering each treatment with respect to the simple condition that post-treatment be either lower than the pre-treatment as vs. equal or higher, the following analysis was carried out:

Examination of scattergrams showing the post-treatment and the pre-treatment value relationships for each individual for each treatment indicated that (for each treatment) there were large numbers of individuals whose pre-treatment measurement was low (say less than 20 mm. of water), and who thereby might be considered to have a lessened opportunity to show a reduction in airway resistance even under the condition of high efficacy of the treatment in question. Individuals were thus separated (see Fig. 9) according to pre-treatment measurement in order to group those persons who had a low pre-treatment measurement (zero through 19 mm. of water) as vs. second group with 20 or more mm. of water in their pre-treatment measurement.

The proportion with lower post-treatment measurement for the 0-19 mm. of water pre-treatment group is highly variable among the several treatments. The proportion of cases with lower post-treatment measurements for those individuals with higher pre-treatment measurements was considerably more consistent. Chi-square analysis of the results of the four-fold table for each treatment (see Fig. 7) indicates that Ephedrine, Phenylpropanolamine, and the placebo show a significant relationship between pre- and post-treatment measurement.


Rhinometric Evaluation
Treatment 1
Treatment 2
Treatment 3
Post-treatment X_2
X_1 = Pre-treatment
20 40 60 80 100 120 140 160
20 40 60 80 100 120 140 160 180 200

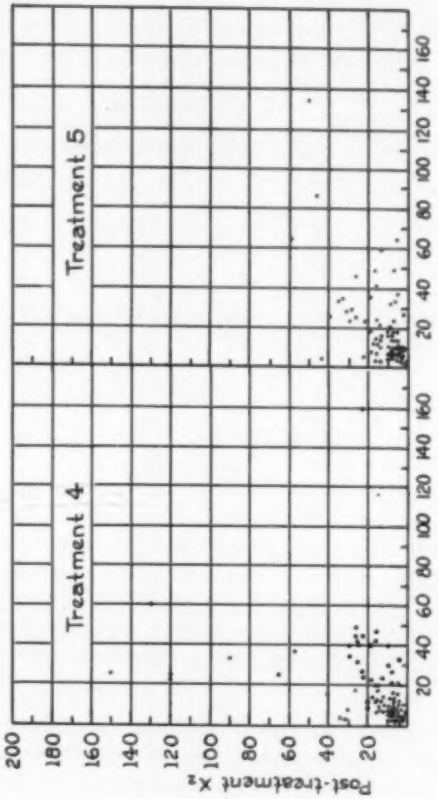


Fig. 8. Scattergrams of each treatment.

Inspection of the scattergram for Phenylpropanolamine and placebo will indicate that apparently the chi-square significance is related to a large number of points indicating a low pre-treatment measurement. The scattergram implies that Phenylpropanolamine may have been deleterious at high pre-treatment levels, and that the placebo may have been efficacious at low treatment levels.

Pre- and Post-Treatment Measurements.

Treatment	Grouped Pre-treatment Measurement (mm. H_2O)	Post-treatment Measurement Compared to Pre-treatment Lower	Equal or Higher	Total
A	0-19	28	33	61
	20+	21	6	27
	Total	49	39	88
B	0-19	32	33	65
	20+	15	8	23
	Total	47	41	88
C	0-19	33	26	59
	20+	18	11	29
	Total	51	37	88
D	0-19	21	34	55
	20+	25	7	32
	Total	46	41	87
E	0-19	37	23	60
	20+	24	4	28
	Total	61	27	88

Fig. 9. Tabulation of individuals according to pre-treatment measurement of 19 mm. or less, and those with 20 mm. or more. Post-treatment measurements show more improvement in nasal airway (with drugs A, D, E) in the presence of great amounts of nasal obstruction before treatment.

Ephedrine is "significant" at the 5 per cent confidence level, apparently attaining this status due to reduction in airway resistance at higher pre-treatment levels.

Analysis of differences between means of pre-treatment vs. post-treatment rhinometric measurement for the five treatments (see Fig. 10) indicates that the pre-treatment and post-treatment mean could have come from the same population in more than 95 out of 100 paired samples of this size

(88) for Phenylpropanolamine, Phenylephrine, Pseudoephedrine, Placebo.

For Ephedrine, however, the difference in means for pre-treatment vs. post-treatment evaluation is significant at the 5 per cent level of confidence. Since the post-treatment measurement is lower, the conclusion is that Ephedrine had effect in reducing airway resistance. No such evidence exists to support this conclusion for the other four medications.

Rhinometric (mm. H_2O).

Treatment	Mean Pre-treatment Measurement	Mean Post-treatment Measurement
1	20.40	19.89
2	18.53	17.18
3	24.38	21.45
4	19.03	19.88
5	20.25	12.53
Average over All Treatments	20.52	18.18

Fig. 10. Averages of pre-treatment and post-treatment rhinometric measurements.

COMMENTS.

Ephedrine has proven objectively, by rhinomanometric measurement, to be significantly greater in its ability to produce nasal mucosa shrinkage. Although the weight of extraneous factors decreases the sensitivity of our method, the fact that the placebo effects were roughly equal to those of Phenylephrine, Pseudoephedrine, and Phenylpropanolamine implies the general lack of significant nasal mucosa vasoconstriction.

It is our opinion, however, that by way of compounded preparations, the additive effects of antihistamines and these sympathomimetic amines do sometimes provide an improved nasal airway by oral administration. Rhinometric studies supporting subjective reports would certainly be rewarding evidence.

The results of our studies on humans imply, as did Aviado's, that we cannot always know that every sympathomimetic

agent given systemically acts on the terminal nasal vessels as it does on another part of the vascular tree.

It would be a most desirable additive to the general knowledge on any of these drugs, if others could confirm or prove otherwise the actual effects on the human nasal airway, particularly demonstrating incremented effects, using graded doses of a single drug.

CONCLUSION.

Sympathomimetic amines used "alone" as an oral medication in *subjective* comparison studies have been found equally effective as a placebo in providing an "improved nasal airway." *Objective* findings of the same series of patients, by rhinometric measurements, show Ephedrine to be significantly effective. Phenylpropanolamine, Pseudoephedrine, and Phenylephrine were as effective as the placebo. Blood pressure and heart rate observations suggest caution when used in patients with cardiovascular disorders. The subjective declarations of effects do not statistically have any correlation with the rhinometric results. Insomnia was found more frequently with Ephedrine and Pseudoephedrine.

We are indebted to Dr. Robert Lewis of the Tulane Biostatistics Department for his assistance in analyzing our data.

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3888 Government Street.

THE WEST VIRGINIA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

News Release.

Fourteenth Annual Spring meeting of the West Virginia Academy of Ophthalmology and Otolaryngology will be held April 6-8, 1961, at Greenbrier Hotel, White Sulphur Springs, W. Va., with the following guest speakers in attendance:

1. Harvey E. Thorpe, M.D., Pittsburgh, Pa.: 1. Recent Developments and Personal Experiences in Cataract Surgery; 2. Clinical Gonioscopy.

2. John J. Shea, M.D., Memphis, Tenn.: 1. Fenestration of the Oval Window After Five Years; 2. Vein Graft Tympanoplasty.

3. F. Johnson Putney, M.D., Philadelphia, Pa.: 1. Laryngeal Keratosis: A Clinico-Pathologic Problem; 2. Neck Dissection in Cancer of the Larynx.

4. Irving H. Leopold, M.D., Philadelphia, Pa., will give two lectures in which the titles will be announced later.

Mr. Philip Salvatori of Obrig Laboratories will present an entire afternoon session devoted to "Contact Lens."

The new officers of the Academy will be installed at that time.

Registration fee is $25.00. For additional information, please contact the secretary, Dr. Worthy W. McKinney, 109 East Main Street, Beckley, W. Va.

MONOSTOTIC FIBROUS DYSPLASIA OF THE TEMPORAL BONE.

Report of a Case.*

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INTRODUCTION.

Monostotic fibrous dysplasia is a skeletal developmental anomaly affecting one bone, the medullary cavity of the involved bone being filled with gritty, grey-white fibrous tissue containing trabeculae of newly formed primitive bone. The condition, according to Lichtenstein, apparently results from the perverted activity of the bone-forming mesenchyme. It manifests itself in childhood or early adult life and evolves slowly, pursuing a protracted clinical course characterized by deformity and a tendency to develop pathological fractures of the affected bones.[1]

Prior to 1938, when Lichtenstein first called the disease "fibrous dysplasia," many other terms were used. He mentions that there were at least 33 other names for the disease. These included osteitis fibrosa, osteodystrophia fibrosa, fibrocystic disease of bone, von Recklinghausen's disease of bone,[2] ossifying fibroma, giant cell tumor of bone, osteoid osteoma, fibroseptic disease of bone, osteodystrophy,[3] leontiasis ossea, juvenile Padget's disease, and osteitis fibrosa cystica.[4]

Fibrous dysplasia may manifest itself in three different ways:

1. Monostotic fibrous dysplasia, involving only one bone.

2. Polyostotic fibrous dysplasia (Jaffe-Lichtenstein disease), involving more than one bone.

3. Albright's disease,[5] consisting of polyostotic fibrous dys-

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plasia, cafe-au-lait spots, precocious puberty in females, and, occasionally, hyperthyroidism.

Although fibrous dysplasia may occur in many bones of the body, it rarely develops in the temporal bone. Since 1938 only four cases of monostotic fibrous dysplasia of the temporal bone, proven by biopsy, have been reported in the English literature. This is the fifth case.

REVIEW OF OTHER CASES.

Schlumberger,[6] in his classical report of 67 cases of monostotic fibrous dysplasia, reported a 12-year-old boy with frequent earaches in childhood, who suddenly developed a painful swelling behind his left ear. At surgery, the mastoid cavity contained tissue reported as fibrous dysplasia.

Towson[7] presented a 14-year-old boy was was hit behind the right ear five years prior to being seen. This patient had a hard mass behind the ear, pushing the auricle down, as well as a mass in the right external auditory canal. Following a radical mastoidectomy, a cystic mass diagnosed as ossifying fibroma was reported.

A 29-year-old male, who also had his right external auditory canal obliterated by a mass, was reported by Brunner.[8] The maxilla was also involved. Biopsy of both of these areas showed fibrous dysplasia. This, in reality, was not monostotic fibrous dysplasia, as more than one bone was involved.

Kearney[9] described a 21-year-old male patient with an exostosis in his right external auditory canal, which was removed three times prior to a radical mastoidectomy. A report of fibrous dysplasia was returned. He makes the point that fibrous dysplasia may present itself as an exostosis in the external auditory canal.

Even though fibrous dysplasia is rare, it must be considered in the differential diagnosis of bony masses presenting in the external auditory canal.

CASE REPORT.

This patient is a 19-year-old white female who was in good health until

three years ago, at which time she developed intermittent, non-specific headaches that have continued to the present time. She first appeared at the E.N.T. clinic in August, 1959, with a complaint of a hearing loss in her left ear which had been progressive over the past three years. Until one year ago, her hearing could be improved by pulling her auricle posteriorly and superiorly. A history of discharge, vertigo, or tinnitus was denied, and, other than her hearing loss and headaches, the patient had no other complaints.

Physical examination revealed a bony mass in the left external auditory canal. The tympanic membrane could not be seen. A fullness was present involving the left side of the skull anterior to the ear, but no masses could be palpated. Tuning fork tests with the 512 fork showed

Fig. 1. Stenuer's view. Arrows at top show the dense bone in the petrous pyramid and periantral area.

a negative Rinné test. The Weber lateralized to the involved ear, and prolonged the Schwabach on the left. An audiogram revealed a normal bone curve and an air curve averaging a loss of 60 db. A set of X-rays taken preoperatively were read as showing an osteoma in the left external auditory canal.

The patient was taken to surgery, and, through an endoural incision and elevation of skin over the posterior canal wall, the mass was exposed. During the removal, it appeared gritty, fibrous, vascular, and spongy, and could be scooped out with a curet. Having realized an osteoma was not being dealt with, an unsuccessful attempt was made to obtain a frozen section. After creating a cavity 2 cm. deep and 1 cm. in diameter without reaching normal bone, the procedure was terminated. A biopsy was then taken, through a second incision, from the squamosal part of the temporal bone, anterior and superior to the tragus and beneath the temporalis muscle. The postoperative course was uneventful.

Three weeks later, 50 per cent hypaque was instilled into the operative cavity to outline its depth radiologically. The cavity of the middle ear had not been reached. A second set of X-rays was then taken. The report on the left ear is as follows: "The pneumatization of the left

temporal bone is limited to the mastoid process. For the most part the cell walls are thin and intact, and the air content appears normal. There is no visible external auditory canal, except for the surgical defect under investigation. There is no clean, air-containing, tympanic cavity visible. The normal cellular pattern of the attic is not demonstrable. There is no evidence of bone destruction in the area of the aditus or antrum. The mastoid cells lateral to the superior semicircular canal appear to have considerable thickening of these walls. The anterior canal wall is grossly thickened and the hyperostosis extends well toward the root of the zygoma. The internal auditory canal, cochlea, and semicircular

Fig. 2. Submento vertex view. Central arrow shows the contrast media in the deepest part of the operative defect. Left arrows show the great thickening of the outer table of the skull. Right arrow shows the ossicles in the cloudy tympanic cavity.

canals appear normal, except that the petrous pyramid is considerably more dense than on the right. The operative defect appears to stop approximately one-half centimeter from the area of the tympanic cavity. Diagnosis: Probable fibrous dysplasia of the temporal bone" (see Figs. 1, 2, and 3).

The biopsy report was returned as fibrous dysplasia (see Fig. 4).

Further evaluation of the patient showed no cafe-au-lait spots, hyperthyroidism, or history of precocious puberty. A skeletal survey of the spine, long bones, ribs, and pelvis was normal. The blood calcium was

9.7 mgm. per cent, the phosphorus 4.0 mgm. per cent, and the alkaline phosphatase 2.5 units, all normal.

A diagnosis of monostitic fibrous dysplasia was made. In view of the extensive disease, no surgery is contemplated. There has been no progression of the disease since the patient has been under our care.

DISCUSSION.

Fibrous dysplasia is a disorder of young people, especially

Fig. 2. Meyer view. Left arrows show the post-operative defect. Right arrows show the thickening of the bone of the Squama temporalis.

of females. Apparently, it starts in early life, reaches its maximum activity at puberty, and then becomes quiescent. Most of these people are otherwise in good health.

The etiology of fibrous dysplasia is not known, although many theories have been suggested. Lichtenstein and Jaffe[2] felt that it represented a congenital anomaly of development,

resulting from a perverted activity of the bone-forming mesenchyme. Geschickter and Copeland[10] believe that fibrous dysplasia is a true dystrophy in which the tendency of the mesenchyme to normal ossification is blocked or prevented by a fundamental disturbance yet to be demonstrated. Albright,[4] in discussing the syndrome that now bears his name, suggested that some hypothalamic lesion in the region of the third ventricle may produce disturbances in the anterior lobe of the pituitary, resulting in abnormal stimulation of various trophic hormones. This may explain the precocious puberty and hyperthyroidism. Schlumberger[6] and Towson[7] felt that trauma was the causative agent. Thannhauser[11] thought that the connective tissue in the lesions represented a neurofibroma and that the polyostotic form is similar to von Recklinghausen's disease.

Monostotic fibrous dysplasia may invade the spine, pelvis, long bones, ribs, and skull, in the latter most often affecting the maxilla, zygoma, and mandible.[15] Its most outstanding feature is connective tissue replacement of the marrow cavity and its cancellous bone, with a feeble attempt at osteogenesis.

Grossly, the spongy bone of the marrow cavity is replaced by whitish, red-speckled, rubbery, compressible tissue that may be gritty in part or throughout. The grittiness owes its presence to formed trabeculae of immature bone.[3] The destruction of the marrow cavity is due to excessive osteoclastic activity and lacunar resorption. This, in conjunction with newly formed connective tissue, results in primitive nonlamellar bone which occasionally may undergo calcification. As a result, the bone is expanded and deformed, the cortex decreasing in size while the center grows. Metaplastic bone may be laid down on the newly formed fibrous tissue, and, occasionally, islands of cartilage develop and cysts form.[13]

Microscopically, fibrous tissue is seen through which trabeculae of poorly formed primitive bone are scattered. The connective tissue is usually rather cellular and made up of immature, small, slender, spindle-shaped cells arranged in a rather loosely whorled manner and fairly well vascularized. The lesion, at times, however, may be poorly cellular and

highly collagenous in character. The trabeculae are of various sizes and shapes and are irregularly distributed throughout the lesion, although they are greater in number in the more cellular and vascular areas.[3] Infrequently, focal degeneration may result in the formation of cysts.[12] In the cystic areas, multinuclear giant cells and a few foam cells may be seen.[3]

The symptoms presented vary with the bones involved. A local swelling, with or without pain, local tenderness, or

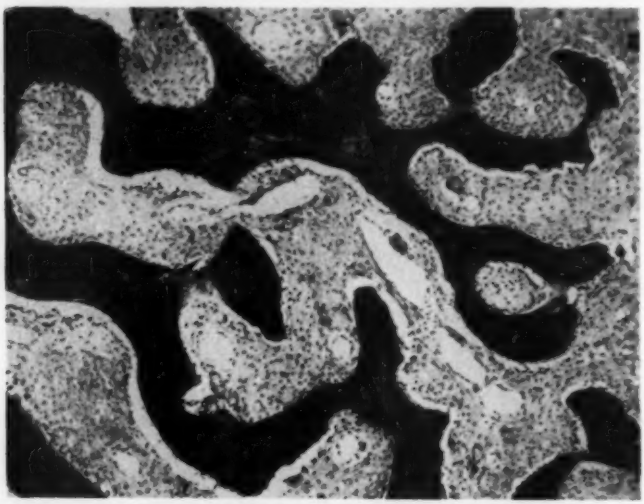

Fig. 4. Typical appearance of lesion with coarse fiber bone, and geometric pattern in a cellular spindle cell stroma. Pathological diagnosis: Fibrous dysplasia (osteoblastic hyperplasia).

asymmetry, may be the earliest clue. At times, fibrous dysplasia may be discovered accidentally.

In the temporal bone, tinnitus, conductive deafness, or a mass in the external auditory canal may be present. Due to the slow involvement, vertigo is not usually a symptom, the labyrinth having time to compensate.[14]

In monostotic fibrous dysplasia, the calcium, phosphorus,

and alkaline phosphatase are normal.[7] In polyostotic fibrous dysplasia, the alkaline phosphatase and calcium may be increased depending on the bony involvement. The urine calcium and phosphorus are either normal or elevated.[16]

The radiographical picture represents the pathology that is present, with the X-ray findings depending upon the tissue in the cavity and the effect of this material on the bony cortex.[3] The cortex may be thick or thin and show a sclerotic appearance. A rarified, trabeculated appearance of the spongy structure with fibrous or osteoid tissue having a low degree of calcification may give rise to a cystic appearance, as it is more radiolucent than the surrounding areas of bone.[15] The cysts may be irregular in character, ranging up to 2 - 3 cm. in size.

The X-ray diagnosis may be based on:[12]

1. A cystic area eccentrically in the involved bone.

2. Trabeculations in the cyst with a smudge of increased density.

3. Opaque margination around the cyst which takes off into the surrounding bone.

If one encounters roentgenographically a lesion suspected of representing fibrous dysplasia, a search for additional lesions is indicated.[2] The diagnosis, although strongly suggested by X-ray, can be confirmed only by biopsy.

Whenever possible, surgical removal is desired, keeping in mind that the lesion is usually self-limited. Conservatism is the procedure of choice. At times, no treatment may be warranted.[1,15] Each case must be evaluated separately.

Davis,[12] in the literature, mentions 11 cases of sarcoma developing from fibrous dysplasia. Lichtenstein and Jaffe[2] state that fibrous dysplasia will not interfere with normal life expectancy. The disease is self-limiting, and symptoms decrease as the patient grows older. An equilibrium point will be reached, and no new lesions will appear.[16] The deformity may never disappear, but the disease usually remains quiescent after puberty.[14]

SUMMARY.

Fibrous dysplasia is a rare disease affecting bone, the medullary cavity of the involved bone being filled with gritty, grey-white fibrous tissue containing trabeculae of newly formed primative bone.

It may manifest itself in three different ways:

1. Monostotic fibrous dysplasia, involving only one bone.

2. Polyostotic fibrous dysplasia (Jaffe-Lichtenstein disease), involving more than one bone.

3. Albright's disease, consisting of polyostotic fibrous dysplasia, cafe-au-lait spots, precocious puberty in females, and, occasionally, hyperthyroidism.

Since 1938, only four cases of monostotic fibrous dysplasia of the temporal bone, proven by biopsy, have been reported in the English literature. The case presented is the fifth. This patient had an exostosis of her external auditory canal and a conductive deafness.

Fibrous dysplasia is a disease of young people, usually reaching its maximum height at puberty. The cause is not known, although a developmental defect seems most likely.

In the temporal bone, a conductive deafness and a mass in the external auditory canal may be the only findings. Diagnosis, although suspected by X-ray, can be made only by biopsy.

Treatment consists of surgical removal, when possible, keeping in mind that the lesion most often is self-limited.

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CORRECTION.

In the November 1960 issue, in the paper on "Kaposi's Sarcoma of the Auricle" by Drs. Naunton and Stoller, errors were made in placing the illustrations above their proper legends. Thus the cut described as Figure 1 is, in fact, Figure 2; that described as Figure 2, is Figure 3, and the cut described as Figure 3, is Figure 1.

CLINICAL TRIAL WITH TRICLOBISONIUM CHLORIDE* IN THE TREATMENT OF B. PROTEUS EAR INFECTIONS.

A Preliminary Report.

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Treatment of *B. proteus* infections is one of the current problems of antibacterial therapy[1,2] chiefly because of the resistance of this organism to many antibiotics and other antimicrobials. After the sensitive flora have been eliminated by routine antibiotic therapy *B. proteus* often remains as a resistant pathogen in mixed infections.[3,4] The incidence of proteus in routine cultures of all sorts appears to be on the increase,[1-4] and when this organism is implicated in ear infections, the disease becomes more complex, and treatment continues to be a perplexing problem in otology.[2,3] Antibacterial therapy in most infections of the ear is often unsuccessful when this organism is involved, and a new agent which might be effective is, therefore, of interest.

Triclobisonium chloride, a bisquaternary ammonium compound, is an antimicrobial possessing marked activity both *in vitro* and *in vivo* against a broad spectrum of microorganisms[5-7]; it has also been reported to be clinically effective in *B. proteus* infections.[8,9] It has been used effectively as a topical medicament for a wide variety of superficial infections producing a minimum of side effects,[6-11] but has not been used previously in the form of an otic solution. It was decided, therefore, to evaluate its effectiveness in the treatment of ear infections associated with *B. proteus*.

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MATERIALS AND METHODS.

Triclobisonium chloride otic solution was administered to 27 patients ranging in age from three months to 54 years with various ear infections all involving *B. proteus* as the predominating organism, with other bacteria present only as contaminants. The conditions treated were acute suppurative otitis media, chronic otitis media, chronic otitis media with mastoiditis and diffuse otitis externa. Seventeen patients had had previous medication consisting of other otic solutions and

TABLE I.

Summary of Results of Treatment with Triclobisonium Chloride Otic Solution.

Indication	No. of Patients	Organisms Cultured	Results		Side Effects
			Satisfactory	Unsatisfactory	
Chronic Otitis Media	15†	B. proteus Diphtheroids Pseudomonas	6	9	2-burning
Chronic Otitis Media with Mastoiditis	3	B. proteus, small number contaminants	3		0
Acute Otitis Media	6*	B. proteus, small number contaminants	6		0
Diffuse Otitis Externa	3	B. proteus Diphtheroids	3		0
Totals	27		18	9	2

*Four patients received systemic antibiotics.

†Repeat cultures in five patients indicated Pseudomonas was predominant with few B. proteus present.

systemic antibiotics, all of which failed to resolve the persistent ear discharge. Two patients had undergone surgical procedures (radical mastoidectomy and tympanoplasty) four months prior to treatment.

All patients were administered triclobisonium chloride otic solution, three drops twice daily, for a duration ranging from one week to 14 days. Four patients, all under six years of age required systemic antibiotics as concurrent therapy because of accompanying high fever. All others received no additional therapy.

Culture studies performed on all patients indicated that *B. proteus* was the predominant organism in every infection,

with Pseudomonas, diphtheroids and other bacteria present only in small numbers as contaminants.

RESULTS.

Of the 27 patients, results were satisfactory in 18. Triclobisonium chloride completely cleared the infection within seven to ten days of treatment. Concurrent antibiotic therapy did not shorten the course of treatment. In the four children who received systemic antibiotics, the discharge did not clear until the twelfth day of medication.

Results were unsatisfactory in nine patients. Two of these experienced a severe burning sensation when the solution was instilled in the ear after four days, and treatment was discontinued. Repeat cultures were obtained in the other seven patients. *Pseudomonas* was the predominating organism in five patients instead of the previously predominant *B. proteus* and in two patients *B. proteus* was still the predominant organism.

DISCUSSION.

Although the number of patients in this preliminary study is small, the results assume significance in view of the current problem of resistant proteus infections for which, clinically, there has been no strikingly effective agent.[3] Treatment of chronic ear infections has been much less successful than of acute infections.[12,13] Since two-thirds of the patients in this study suffered from chronic otitis media, the results obtained indicate that this preparation has great value for both chronic and acute ear infections in which *B. proteus* is the causative organism.

SUMMARY.

Triclobisonium chloride otic solution was administered to 27 patients with various ear infections all involving *B. proteus* as the predominant organism.

Treatment for an average of seven to ten days successfully cleared the infection in 18 patients. Systemic antibiotics

administered to four patients did not shorten the course of treatment.

Results were unsatisfactory in nine patients. Two of these experienced a burning sensation when the solution was instilled in the ear after four days and treatment was discontinued.

The clinical effectiveness of triclobisonium chloride against *B. proteus* in this preliminary study warrants further similar investigation in view of the current difficulty of treating infections involving this organism.

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AN UNUSUALLY LARGE MIXED TUMOR OF THE PAROTID.

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and
RICHARD C. PARSONS, M.D.,
Battle Creek, Mich.

The purpose of this report is to present a technique for removal of very large parotid tumors with preservation of the facial nerve. In dealing with smaller tumors in this region, the normal anatomical relationship of the VIIth nerve may be used for its identification and dissection; however, in unusually large lesions, this relationship may be greatly distorted and branches could be so superficial as to be severed by the initial incision. A unipolar electrical stimulator capable of localizing branches by percutaneous stimulation, as well as in tissue dissection stimulation, was used in this case. This instrument supplies Faradic voltages graduated from one-fourth volt to five volts in fine steps, and also ten, 20 and 30 volts. The use of a transparent drape over the face, allowing the surgeon to visualize facial responses to stimulation, is most helpful in this procedure.

CASE REPORT.

A 78-year-old Negro lady was first seen in January of 1960 with a large tumor of the left parotid gland. A close friend of the patient stated that this mass had been so disfiguring that the patient had not left the confines of her home for over ten years. There had been gradual increase in size for at least 13 years. She had no history of other serious illnesses.

Upon examination, there was a lobulated, firm, slightly movable mass measuring 10 x 8 cm., and projecting 8 cm. from the face. The overlying skin was thin and, in places, adherent. The skin of the ear lobule was completely stretched by underlying tumor until the configuration of the lobule was no longer apparent. There was no weakness of the facial musculature. There was no intrapharyngeal extension of the lesion. Some areas were fluctuant, but there was no ulceration.

Excision of this lesion was performed under endotracheal general anesthesia. The left side of the face and neck was prepared and draped with transparent plastic sheeting covering the face. Using the stimulator set

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Fig. 1. The pre-operative appearance of tumor.

Fig. 2. The results one week following operation.

at 20 volts, the entire superficial surface of the tumor was explored, and the locations of the temporal, zygomatic, buccal and mandibular branches of the facial nerve were identified before the incision. Incisions were planned and carried out in order to avoid these branches, and to preserve the contours of the ear; also, to utilize any normal skin for closure. Adherent skin was removed with the lesion. Dissection was carried around the anterior aspect of the tumor, using voltages of one-fourth to one volt for identification and preservation of individual nerve branches. These were traced posteriorly, elevating the mass, until the entire pes pattern was visible. The tumor was then separated from the cartilaginous ear canal, sternocleidomastoid muscle and mandible, and was removed

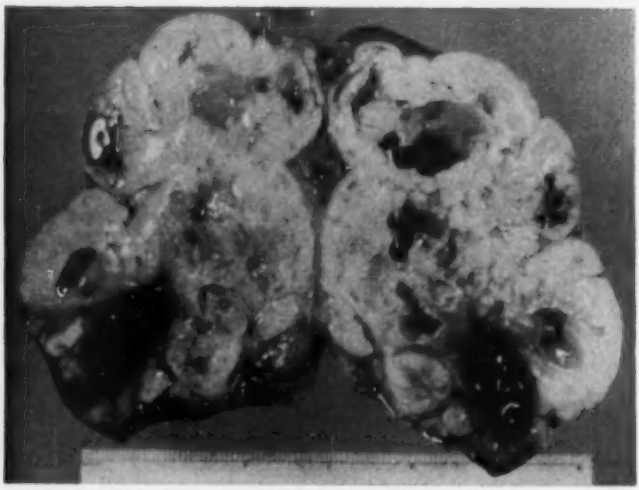

Fig. 3. The cut gross specimen is compared to a six-inch ruler.

Fig. 4. The nerve stimulator with unipolar probe.

intact. At this time, stimulation of the main trunk with one-fourth volt produced complete facial response. Primary closure was accomplished, utilizing existing flaps. Total operation time was four hours.

Sutures were removed in seven days following excellent primary healing. There was no weakness of any of the facial musculature.

SUMMARY.

A case of an unusually large parotid tumor is presented, and a safe and expedient technique of removal described.

513 Michigan National Bank Building.

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